Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

KANSAS MOSSES.

By Miss MINNIE REED.

The special study of *Musci*, as well as other Cryptogams, is of comparatively recent date, as scarcely anything was known of their anatomy, reproductive organs, or life history, until near the end of the last century.

This, the nineteenth, century is an age of specialists, who, during the last 25 years have made wonderful discoveries by their careful and thorough investigations. As a result of this specialization, all the sciences have made marvelous progress.

One man no longer tries to master the whole of natural history, nor even the whole of botany; but taking a single order or group, he devotes most of his time to it, until he understands its entire life history, with all its variations and affinities; and he becomes an authority upon that subject. Thus we have bryologists, or moss specialists; mycologists, or fungi specialists, etc.

The ancients scarcely noticed mosses, while none were distinguished individually from the general group Muscinae, except one about which there was a popular superstition. This moss was known as Muscus crani humani, or moss of the human skull; and was supposed by the old herbalists to be a certain cure for any disease of the head.

At this time plants of all kinds were only studied for their medicinal virtues, all other considerations being deemed unimportant.

For a long time mosses were confused with lichens and algae; even after they had been studied specially. Such forms as the ordinary brown sea weed (Fucoidae) and the so-called Irish moss (another alga), with many of the lichens that resemble mosses, were for a long time classed with Muscineae.

Before the sexual organs of mosses were discovered, many quaint ideas about their reproduction were held, even by the leading botanists.

Linnaeus had an entirely erroneous idea of these organs, and reversed the sexes; supposing the capsule containing the spores contained instead, the the pollen for fertilization; and that the antheridia, or real male organs, bore the seeds.

The first work written about mosses alone, was published in 1741, and called "Muscorum Dillenius." It contained many excellent engravings, though there were some lichens and algae included, because of their external resemblance.

Some writers credit Micheli with being the first to understand the structure of mosses, and make the drawings of their reproductive organs. These were made in 1729, over 50 years before Johannes Hedwig, the father of bryology, published his great book on Musci. There is reason to believe that Hedwig was really the first to fully understand the sexual organs, and distinguish the two kinds; and it is certain that his was the first great book on Musci. His work was very carefully done, and his identifications of both species and genera were very correct; so that many mosses still bear his name.

Bridel came soon after Hedwig, with his "Bryologia Universalis", and other books on Musci. He, too, was an authority, a keen observer, and discovered and described several new species.

Unger observed the spermatozoids as early as 1837; and Hofmeister in

1849 first propounded and explained the alternation of generation in his splendid book, "Die Entschung des Embryos der Phanerogamen", showing the whole course of development of Muscineae and vascular cryptogams; and the true relation between the asexually-produced spore, and the sexually-produced embryo or sporophore, as well as the genetic relation of Cryptogams and Phanerogams.

After these men came Prof. W. P. Schimper, also a German, who was, in his day, the greatest living authority on Music. His greatest work, "Bryologia Europaea", is a standard work of great value, adding very much to the knowledge of bryology.

Mueller, Hampe and Lindberg were all well-known bryologists and also Germans.

Of the English bryologists, the most prominent are: Wilson, now dead, Mitten and Doctor Braithwaite, who are still living and working. Doctor Braithwaite has just published a valuable book called "Handbook of English Mosses", which is very clear, concise, and accurate.

Renauld and Cardot are two French bryologists still working, who have identified and named most of the Kansas mosses thus far reported.

The first work on mosses in America was done by Doctor Muhlenberg, a Lutheran minister of Lancaster, Penn., who published a catalogue of over 170 species; principally named by Hedwig and Beauvois.

Later came Sullivant, who published his first edition of 205 species of mosses, and later, in the year 1856, the second edition, containing 410 species.

James and Lesquereux began their "Manual of North American Mosses"; but before it was completed James died (1882), so that Lesquereux finished it in 1884, with some aid from Watson, Renauld, and others. This manual describes 128 genera, and nearly 900 species; but only the northern and eastern states were thoroughly represented, as but little collecting had as yet been done beyond the Mississippi river, or in the gulf states.

There are a number of active bryologists in the United States now, though most of them are comparatively young. Of these older ones, Macoun, Eugene Rau and D. C. Eaton are best known, while of the younger ones, Mrs. E. G. Britton and C. R. Barnes are most prominent. Mrs. Britton is now writing a "Handbook of Mosses of Northeast America", which will be a very valuable addition to American bryology. This will be published soon, we hope.

Next in importance comes C. R. Barnes's "Artificial Key to North American Mosses", published in 1890. This is a very great help in identifying mosses, in connection with Lesquereux and James's Manual, making the latter twice as clear, and hence more valuable.

Recent additions to North American mosses have increased the number to something over 1,000 species; and still but little territory has been studied.

Kansas, like most of the western states, has had but little work done on her mosses. In 1884, the first list of Kansas mosses was published in the "Washburn College Bulletin", edited by Prof. F. W. Cragin. The collecting was done by Professor Cragin's students chiefly, while the specimens were sent to Eugene Rau for determination.

This list contained but 12 species, all from the immediate vicinity of Topeka. Additional species were reported from time to time, and the lists published in the "Washburn College Laboratory Bulletin", giving new localities for mosses previously reported, until the fourth and last list was published in 1886, numbering 53 species in all. These last lists included collections from various counties over the state, many specimens being collected in

Saline county, by Dr. Joseph Henry, who, though only an amateur and over 70 years old, was nevertheless an enthusiastic collector. He died in October, 1887. Renauld and Cardot determined Dr. Joseph Henry's collection of Saline county mosses, which extended through more than three years of careful work, and was published with Cragin's last list in the Botanical Gazette, vol. XVII, p. 81. There were 40 species added to the old list, making 93 species in all (besides eight varieties) reported from Kansas in 1892.

I find that with the addition of the mosses published in Smyth's Check-list last year, with the 30 additional species which I have collected, not previously reported from Kansas (besides one entirely new species), that we have a list of 165 species. This list will probably be increased when the remainder of my material has been identified. Most of my specimens were collected in the eastern third of the state. The larger part of the collecting has been done in Wyandotte, Riley, and Pottawatomie counties, with a few specimens from Bourbon county, collected by Rev. John Bennett; from Franklin county, by Grace R. Meeker; from Shawnee county, by J. W. Beede and B. B. Smyth; from Atchison county, by E. B. Knerr, and a few from Wilson county, collected by Frank McClung; I also have one specimen from Rooks county, sent by E. Bartholomew, and a few from Trego, Greeley, and Anderson counties, collected by myself. The kindly assistance of the above collectors has aided me very much in securing material for study and comparison.

Bryophytes, or mosses, rank fourth in the subdivisions of the vegetable kingdom, coming just above Fungi and below Pteridophytes, the vascular Cryptogams or ferns. The Bryophytes include two orders: the Hepaticae, or liverwort mosses, and Muscineae, or true mosses. The order Muscineae is characterized by two generations—sexual and asexual. The sexual generation contains abundant chlorophyl, and is the direct growth of the spore, or in mosses preceded by the more simple protonema, which, though chlorophyllose, does not bear the sexual organs, but produces buds for the leafy plant or stem, which leafy stem constitutes the moss plant proper, producing the sexual organs.

The female sexual organ, when fertilized, produces the sporophore, or asexual generation; which is very different from the sexual generation, and produces nothing but spores. This sporogonium, produced from the fertilized oospore of the female flower, is not organically connected with the first generation, but obtains its nourishment from it by absorption, its base being firmly embedded in the tissue at the apex of the stem. This sporocarp finally completes its growth, and develops the spores, ready to germinate and again produce the sexual generation, thus completing the cycle of growth.

The spores of mosses vary in size from one-fifth to 1-500 mm. in diameter; the very minute mosses often having the largest spores; there only being a few in each capsule, as in Ephemerum, Micromitrium, and others, while many of the larger species have the capsule filled with many very fine spores, as in Hypnum, Cylindrothecium, and others. See plates.

The size and surface-markings of the spore are often distinguishing characteristics between species and genera.

The color of spores varies from a dark reddish brown to a light greenish yellow, or almost hyaline, but the usual color is brown.

The surface may be smooth, papillose, verruculose, or slightly irregular. (See plates.)

The shape also varies from spherical to an irregular globoid or angular, the spherical being most common. (See plates.)

The contents of the spore consist of chlorophyl, starch granules, oil globules, mucus, and protoplasm. The spores of some species contain more oil than others, and some are considerably more dense than others.

The outer, thicker coat of the spore (primordial utricle, or moth cell) is termed the exospore, and consists of differentiated protoplasm somewhat similar to cellulose. It is thicker in some species than others. The inner part or contents of the spore is called the endospore.

Spores when placed under favorable conditions, with moisture and warmth, will germinate readily. First the exospore bursts and the endospore protrudes and begins to divide, continuing the division and growth until the long threads form the dense felt-like mat, resembling the light green filaments of conferva, and forming a green film over rocks and walls.

These green threads are termed the protonema, and correspond to the prothallium of ferns. This is the first stage of the development of the sexual generation, from the asexual spore. The long threads elongate by apical growth, forming oblique septa and long cells; and giving rise to branches just back of the septa. The septa are always inclined at different angles, usually in three ways.

The opposite side of the endospore sends out hyaline rhizoids, also obliquely septate, which soon becomes brown. These penetrate the soil and absorb nourishment; thus the protonema develops chlorophyl and supports itself by assimilation. It soon forms leafy buds behind or below the septa or node; the rhizoids develop below, firmly fixing it to the soil, where it soon grows into the leafy axis, or what is ordinarily termed a moss, which is the perfect stage of the sexual generation. (See plates 35 and 36.)

The size and persistence of the protonema varies, greatly in different groups of mosses, it being very small in some species (less than a centimeter), while in others it grows quite large, covering several centimeters with its filaments, which live for some time, but it usually disappears when the leafy axis is developed. In very minute mosses that live but a short time, the protonema grows vigorously, so that all stages of development may be present on one individual, and genetically connected, as in Ephemerum, Micromitrium, and others. (See plates.)

The Sphagnaceae, Andreaeaceae and Tetraphidae differ from the typical mosses in the structure of the sporogonia and in the formation of the protonema. The Sphagnaceae, when growing on a firm substratum, expand into a flat plate of tissue, which branches at the margin, producing the leafy stem from its upper surface.

In Andreaea, according to Kuhn, the contents of the spore divide while still within the closed exospore into four cells, forming a tissue similar to that produced in the spores of some Hepaticae, as Radula and Frullania, and finally from one to two peripheral cells grow into filaments which extend over the sub-stratum. (See "Sach's Text-book of Botany," pp. 361-363, and "Goeble's Special Morphology," pp. 163-166.)

Thus the protonema may develop in three ways, as above described. Protonema may also be produced in numerous other ways, besides germinating from spores, of which further detail will be given later.

The rhizoids, or roots, are of three different kinds, the radical rhizoids, by which the plant absorbs nourishment from the soil, protonemal rhizoids serving the same purpose to the protonema, and lastly adventitious roots on the stem and branches, termed tomentum; which are used for clinging and absorbing moisture—chiefly the latter—and often forming a thick felt on stem and branches, as in Bartramia and Dicranum. (See plates.)

The color of the rhizoids varies from a light brown to a dark purple, the brown being most common. In the cellular structure of all three forms the cells are separated by oblique septa.

In the Sphagnaceae very few small rhizoids are to be found. There is a very close relationship between rhizoids and protonema threads, as each may develop into the other. The rhizoids are hyaline when first formed, but as they enter the soil they become brownish and contain oil drops and considerable protoplasm.

The buds of the protonema develop into the stem or leaf-bearing axis. In the simpler mosses, there is no differentiation in the stem tissue, except that three or four layers of cells are closer and firmer, with an inner axis of fundamental tissue, having larger, thinner-walled cells, as Gymnostomum glaucum, Hedwigia ciliata, and Hylacomium splendens. In others, more highly developed, there is besides, also, an axial bundle of very thin-walled and very narrow cells, and a central bundle or cylinder, as in Grimmia, Funaria, Bartramia, Mnium, Bryum, and many others. The cell walls of the central bundle are thickened perceptibly only in Polytrichum, Atrichum, and Dawsonia. Thus we have all the gradations, from scarcely a suggestion of a vascular system to signs of medullary rays in the most highly developed mosses, which is similar to that of some of the lowest vascular plants. (See "Sach's Botany," p. 365, and "Goeble's Special Morphology," p. 167).

The form of the stem ranges from very short and simple (less than one millimeter in length), as in Phascum and Buxbaumia, to large branched plants, from three to five decimeters long, as in various Hypnum, Polytrichum, Sphagnum, and others.

The diameter of the stem varies from one-tenth millimeter to one millimeter, and is always firm and elastic.

The manner of branching is very characteristic, as it may be dendroid or tree-like, simply or compoundly pinnate, fastigiately or irregularly branched, and either erect or creeping. Again the branching may be complanate or flattened so that the branches and leaves are all in one plane (in this case being usually creeping), or the plants may be pulvinate or closely compact and cushion-like, or simply a tangled mat. In a few cases the plants occur singly, as in Funaria and others.

The color of the stem may be either brownish, yellowish, or more often green and chlorophyllose; and the surface may be either rough and scaly or smooth and shining. The plants are either annual, as in Phascum and others, or perennial, as in Sphagnum, Polytrichum, etc.

Mosses bearing fruit on the apex of the stem belong to the Acrocarpi, while those bearing their fruit laterally belong to the Pleurocarpi. The acrocarpous mosses send out a branch each year, at the apex, just beneath the base of the seta, producing a continuation of the stem called an innovation. The pleurocarpous mosses send out true branches, and have symmetric stems.

The leaves of mosses are always simple, sessile, and arranged in two or more rows, according to the position of the successive segments. If they are arranged in two rows and flattened, they are said to be complanate, as in Fissidens (see plate IV), or they may be in three rows, as in Fontinalis; but in most mosses the leaves are arranged in spirals. The phyllotaxy varies from two-fifths to three-eighths, as in Sphagnum, Andreaea, and Polytrichum.

The leaves may be erect or spreading, turned back, reflexed, curved like a scythe, or falcate, and again turned to one side or secund.

The leaves in some species are large and broad (one-half centimeter long in Mnium and Fissidens), (see plates IV and XXI), or very minute (1 mm.) as in the pseudopodium of Tetraphis, and Aulocomnium.

In some species there are two sizes of leaves, a row of larger leaves on one side of the stem, and a row of smaller leaves on the other, as in Hypopterygium, Rachopilum, and Cyathoparum. Other species have their leaves larger and closer at the apex, termed rosulate, while they gradually grow smaller, until they become scale-like at the base of the stem, as in Funaria, Dicranella, Leptobryum, and others. The leaves may be very close, erect, and overlap, termed imbricate, as in some species of Leucobryum, Thelia, Leskea, and others (see plates V, XI, XXIV, and XXVIII); or the leaves may be very distant, as in Webera albicans, Bryum argenteum, and others (see plates XVIII and XIX). The leaves surrounding the floral organs usually differ from those of the stem in size, shape, color and position, being often crowded into a rosette, as in Mnium, Polytrichum, and others. Some leaves have stipular appendages at the base, called paraphyllia, which are thread-like and chlorophyllose, and probably aid in assimilation. Paraphyllia occur in many Hypna, and serve as distinguishing characteristics between its many subgenera. (See plate XXXIII.)

The leaves of mosses differ less in shape than in phanerogams, though there is considerable variation. They are usually ovate-lanceolate, varying to orbicular, and subulate or awl-shaped.

The base is often decurrent, auricled, or cordate, while the entire leaf may be recurved, very concave, or even carinate. (See plates XXVI, XXIX, XXVIII, and XXXI.)

The apex varies from broadly obtuse to long apiculate, hair- or awn-pointed, and occasionally emarginate, while the two edges of the upper half may be folded together, making it carinate; or the edges may be rolled in towards the center, making it involute, or even tubular.

The edges may be entire, serrulate, dentate, hispid, plane, revolute, involute, crenulate, or wavy; while the border cells may be of different size, shape, color, or thickness. (See plates.) The surface may be smooth on both sides, papillose on one side only, or on both, and hispid or hairy. When only one side is smooth, it is usually the upper. All these differences of arrangement, form, size, margin, nad surface of the leaves are used in identification. All the species blend into each other, making the intermediate forms very difficult to distinguish, even when closely studied with a microscope.

The leaves are sometimes ribbed or costate, and some are ecostate or nerveless; while still others are bicostate, having two rudimentary nerves. The costa may extend beyond the apex into an awn point, when it is called excurrent. If the costa extends only to the tip of the leaf, then it is percurrent, or it may end in the middle of the leaf.

The costa or nerve may be wide or narrow, thick or thin, round or flat, smooth or hispid, or spinulose. It may also vary in color from green to brown, or even purplish. In many species the costa is the distinguishing feature. (See plates.)

A peculiar form of leaf occurs in the genus Fissidens, in which the leaf seems to be vertical, and to have two laminae for part of its length. The split, or seemingly double part, is the true leaf; but the nerve or costa has developed a lamina both on the upper and lower surfaces; which extend beyond the true leaf more than its entire length, and faces horizontally. (See plate IV.)

In Polytrichum and Orthotrichum the nerves are made up of several erect lamellae on the upper surface, and vary in number from two to eight. These lamellae also vary in their height from 4 to 13 cells high, in some species.

The leaves of most mosses are but one layer of cells in thickness; some are two or even three layers thick; while the shape, size, and arrangement of the cells, termed the areolation, varies widely in different families, constituting a basis of classification used by all modern bryologists.

The shape and size of the cells may vary from minute hexagonal or rectangular to large hexagonal or rectangular, rhomboidal, or very long linear, flexuous, or vermicular, according as the areolation is dense or loose. Sometimes the cells are very densely chlorophyllose, as in Atrichum, Timmia, etc.; or the cells may contain but few large chlorophyl grains, as in Mnium, Bryum, and others; again others are without any chlorophyl (hyaline), as in Leucobryum and Sphagnum, having then a whitish appearance. (See plate V.) The basal cells very frequently differ from the upper cells, either in size, shape, color, or in being hyaline, when the upper cells are chlorophyllose, or the reverse. This variation of the basal cells is often used as a specific distinction, and Schimper uses this feature, especially in the genus Dicranum, dividing it into two sections.

When the ends of the cells are rectangular, they are termed parenchymatous, as in some of the Hypna. (See plate XXIV.) When elongated, and pointed or rhombic, the aerolation is prosenchymatous, as in Bryum, and some Hypna. (See plates XXX and XXXII.) Sometimes the walls are very much thickened, producing only a point or dot, as in Grimmiaceae.

Reproduction is accomplished both sexually and asexually. The asexual reproduction is accomplished in many ways; but in almost every case a new plant is preceded by a protonema. In some mosses the leafy buds, becoming detached, or the leafy branches broken from the stem, grow immediately into new plants upon striking the soil; as in Conomitrium julianum, and Cinclodotus aquaticus. A single protonema may produce many plants; or single cells of the protonema may become globular, separate from one another, and lie dormant until next season, as in Funaria hygrometrica, each then growing into a new protonema. The rhizoids, either the aërial or subterranean, may change directly to protonemal threads, as in Bryum, Mnium, Barbula, etc.; or by first forming tubercles containing stored food material, which remain dormant until exposed to light, heat, and moisture, when they develop into protonema, as in Barbula muralis, Funaria hygrometrica, Grimmia pulvinata, Trichostomum rigidum, and Atrichum. (See plates XIV and XXII; see also in Goeble, p. 172.) The aërial rhizoids may produce protonema, with chlorophyl in their cells, and leaf buds directly; and Schimper says the annual male plants are produced in this way by the perennial patches of female plants of Dicranum undulatum, thus accomplishing their fertilization. The cells of leaves may produce protonema by growing out into tubes which become segmented into propagula, as in Orthotrichum lyelli, O. obtusifolium, etc. Club-shaped penicillate tufts of protonema, with short cells, grow on the tips of the leaves of Orthotrichum phyllanthum, Grimmia trichophylla, Syrrhopodon, and Calymperes. Protonema may grow from some leaf tips, from the marginal cells of leaves, as in Buxbaumia aphylla, or from the tips of fertile plants, as in Leucobryum vulgare. The setae or cell walls of the capsule will produce protonema, and also the inner surface of the calyptra of Conomitrium julianum.

Gemmae as well as spores produce new protonema, hence new plants. The gemmae are little spherical cellular bodies containing chlorophyl, which are produced either on the leaves or stem. Aulacomnium androgynum and Tetraphis pellucida bear gemmæ upon the top of prolonged leafless branches, in a delicate cup formed by a few modified leaves. (See plate XXXVI.) There are no plants so well supplied with purely vegetative means of reproduction as the mosses; some never bear fruit; hence these provisions of nature to insure reproduction.

There is no doubt of the existence of sexual organs in mosses. The two organs of reproduction are now well understood.

Just as in Phanerogams the flowers of mosses occur in three forms. The male and female organs may occur in the same flowers, then it is synoecious; or the two organs may be in separate flowers on the same plant, when it is termed monoecious; but if on different plants it is dioecious. Of the synoecious mosses, Mnium cuspidatum and some Brya are examples; of the monoecious species, Atrichum, Polytrichum, and some Hypna, are good examples; while of the dioecious mosses, such common species as Funaria hygrometrica, some Brya and Hypna are examples. The most remarkable example of dioecious moss is found in Fissidens grandifrons; the male plant only being found in Europe, and the female plants only found in America; consequently it is always sterile. Sometimes the male flowers are on smaller, shorter lived plants, as Funaria hygrometrica or Dicranum undulatum, etc. (See plate XIV.)

In the species that are synoecious, all the plants look much like the female plants, but the male plants are usually quite different in appearance from either the female or synoecious plants.

When the plants are synoecious, both organs are in the same receptacle or perichaetium together, or they are separated by special leaves of the perichaetium, arranged in a spiral in the axis of the leaves surrounding the archegonia which are in the center. The female flower usually appears as a long almost closed bud; while the male flower is shorter and more blunt.

The male flowers are borne either terminally or laterally. When terminal the antheridia or male organs are surrounded by leaves variously modified and colored, termed the perigonium. The leaves of the male flower are usually shorter and more blunt than those of the female flower. In some species the lower perigonial leaves form a cup-like receptacle, colored red or orange; inclosing the inner leaves and antheridia, as in Polytrichum, Atrichum, and Pogonatum. (See plate XXII.) Sometimes they are bud-like or gemmiform, and the outer leaves colored red or green. These are always lateral; growing out of the axils of the leaves, as in Hypnum and Cylindrothecium; while in some species they have no perigonium but the leaf from whose axis they grow; and still others grow on a naked stalk, or prolonged stem, as in Tayloria and Splachnum. The perigonium consists of very small modified leaves, which grow smaller and more delicate, as they near the center, and vary in number in different species.

In both male and female flowers, many small filiform bodies, called paraphyses, grow up and help to protect the delicate antheridia and archegonia. In male flowers sometimes the paraphyses are club shaped, but they are always filiform in the female flower. (See plates XIV & XX.) The antheridium is a club-shaped or globose body covered by an outside layer, one cell in thickness, inclosing many free cells within. This outer membrane is chlorophyllose and green until the antheridium ripens; when it changes to a red, brown, or yellowish color. It opens at the apex and bursts the membrane, as in Sphagnum. (See in Goeble's, p. 175, and in Sach's Botany, p. 371.) The spermatozoids are analagous to pollen, hence the name antheridium for the organ containing them. The spermatozoids are also club-shaped bodies, spirally twisted, the pointed anterior end being furnished with two long delicate cilia, which serve as motile organs by vibrating rapidly. Thus they move about swiftly, as soon as freed from the antheridium; though they must always have water in which to float into the open archegonia, and for this reason the antheridia never bursts when dry; the antheridia and spermatozoids are best studied in Polytrichum, where they are comparatively large. (See plate XXII.)

The origin of the antheridium is not uniform, but differs in different species. In Sphagum it originates in the place of a new shoot, while in Fontinalis and most other mosses the origin varies; even being different in the same flower: (see "Goeble's Special Morphology," p. 175, and "Sach's Text-Book of Botany," p. 372.)

The female flower is inclosed in leaves called the perichaetium or perigynum. These leaves also are often much modified, becoming hyaline, delicately membranous, or much elongated into a hairlike point, in some species, while the base becomes sheathing or involute. The perichaetial leaves are usually larger, longer, and more pointed than the perigonial leaves.

The archegonia or female organs, which are analogous to the pistil of a flower, are flask-shaped bodies on a short, thick stalk or seta. The thick part or ventral portion resting on the seta is termed the venter or germen, and incloses the germinal cell or oöspore. The upper slender neck is usually twisted on its axis, and is called the neck or stylidium. The venter wall, before fertilization, is two cells in thickness, and extends up into the neck, which is only one cell thick. This neck or stylidium consists of four or six rows of cells inclosing a central row of cells, termed the canal cells. These canal cells become mucilaginous when the archegonium is mature and receptive; and swell, forcing apart the upper cells, making an open canal down to the oöspore, through which the spermatozoids enter for fertilization. The spermatozoids, as soon as they escape from the antheridium into the water surrounding them, move very rapidly until finding an open archegonium, which they enter, passing down the canal to the oöspore. Schimper and others have seen the spermatozoids in the canal. Usually but one archegonium in a flower is fertilized or develops; but in a few mosses several are matured from the same flower, as in Climacium dendroides, and others. (See plates.)

The origin of the archegonium varies as much as the antheridium; and in Sphagnum it originates at the apex of the female shoot; and also in the typical mosses (see Goeble's Special Morphology, p. 176, and Sach's Botany, p. 375). As the fertilized archegonium grows, the inner leaves of the perichaetium grow larger, forming a sheath around the base of the seta, as in Dicranum, Mnium, and others.

The fertilized oöspore now begins to grow down into the tissue of the apex of the stem, firmly imbedding itself; while it also grows upward, forming a seta or stalk, which bears the capsule or theca inclosing the spores.

The oöspore, in growing upward, tears away the upper part of the archegonium, carrying it upward, where it usually remains attached, forming the calyptra or veil; while the lower part forms a sheath inclosing the base of the seta, called the vaginule.

The sporogonium (sporophore or sporophyte), which the developed oöspore is called, almost reaches a perfect development in the venter of the archegonium of Sphagnum.

In Sphagnum, Andreaea, and Archidium, the seta is very short, but in most mosses it becomes quite long.

The calyptra entirely covers the young capsule, and is usually membranous, thin and smooth; but sometimes it is densely hairy, or hispid, as in Polytrichum and Orthotrichum. Sometimes the apex is straight, and again it is inclined; sometimes it is split up one side, or cucullate; or it may be cone-shaped, with a smooth or irregularly-lobed base, it then being termed mitriform. (See plates.) The capsule or theca varies much in size, shape, surface, and color; but the general form is cylindrical or globose. These forms are modified in many ways, into intermediate shapes, as very long cylindrical, pyriform, elliptical, oval, angled, straight or curved, erect or corneous, or pendulous. Again the capsule may be constricted or widened at the mouth or throat; having a very small or large lid; and sometimes the base is enlarged (called the apophyses); or if only one side is swollen it is termed strumose.

The walls of the capsule are always several layers thick, with a distinct epidermis, and frequently with stomata. Only a part of the central tissue of the sporophore is used in the growth of the sphores; except in Archidium, where it is all finally displaced by the matured spores.

The columella is the central tissue of the capsule, and the mother cells of the spores are formed around it; but the manner of this growth is characteristic in each group of mosses. (See "Goeble's Special Morphology," pp. 177–178, and "Sach's Botany," pp. 374–375.)

The interior of the capsule may develop in four different ways; and, upon this difference, mosses are divided into four divisions or orders.

The central cells of the theca are called the endothecium, and the peripheral cells, the perithecium The endothecium develops an outside layer of cells by division, called the archesporium, which is the spore-forming tissue. This archesporium divides into a mass of spore mother-cells, each of which divides into four spores.

The perithecium grows and forms by cell division, several layers of cells; two of these layers usually being next the archesporium, with an interior cellular space between the outer layers several cells in thickness. This outer layer is connected with the inner layer covering the archesporium (called the outer spore sac). (See Sach's Botany, p. 378.)

The four types or natural divisions of mosses, based upon the development of the spores in the capsules, are as follow: The first and simplest is Sphagnaceae, in which the endothecium forms the columella only, which does not pass through the archesporium, but is covered by it above.

The second type is Archidiaceae, in which the fertile and sterile cells are mixed together in the endothecium, and the spore sac is separated from the wall of the capsule by a bell-shaped intercellular space, and there is no columella.

The third type is Andreaeaceae, in which the endothecium is differentiated into archesporium and columella, but the columella does not pass through the archesporium. The inner layer of the amphithecium becomes the spore sac, which is not separated from the rest of the parietal tissue by an intercellular space.

The fourth type, Bryaceae, is similar to Andreaeaceae, except that the columella passes through the spore sac, which is separated from the walls of the capsule by an intercellular space in the shape of a hollow cylinder.

The operculum covers the top of the capsule, like the lid of a sugar bowl, assuming many shapes and sizes, and varying from the usual conical to long-beaked (rostellate), or plano-convex. The apex may be mamillate, apiculate, straight, or bent, while the surface may be either rough or smooth and the color the same as or different from the capsule, and in many cases forming a specific distinction between the species. (See plates.)

The operculum is forced off the capsule either by the shrinking of the annulus, or by the swelling of the spores, thus allowing their escape and dissemination.

In two subdivisions of the division Musci the operculum is not developed. Andreaea opens by the capsule splitting into four valves, allowing the spores to escape through the spaces. The other subdivision does not allow the spores to escape until the capsule has decayed and broken into fragments. This subdivision includes several genera—Ephemerum, Phascum, etc.; but the larger portion of the division Musci is furnished with a deciduous operculum.

In regard to the operculum the mosses are divided into three groups. The first, called Schistocarpi, are those splitting the capsule into four valves and having no deciduous operculum. The second group, Cleistocarpi, are closed-fruited mosses, those not freeing their spores until the capsule decays. The third group, Stegocarpi, are mosses whose capsules have a deciduous operculum or lid, which opens to free the spores when the capsule is ripe. The annulus is a ring, composed of a row or several rows of cells (from one to four rows), which grows between the lid and capsule. When the capsule is mature this ring of cells contracts on the inner surface, thus freeing the operculum from the capsule. The annulus is usually fugacious, but in some cases it is persistent, and is either simple, compound, or revoluble, as in Funaria; or it may be entirely wanting. The compound revoluble annulus of Funaria hygrometrica is especially good for studying. (See plate XIV.)

The mouth of the capsule when the lid is removed, may or may not have a peristome or teeth. If the mouth is naked or without a peristome, it is termed a gymnostomous moss; but most mosses have either a single or double peristome. When there are two rows of teeth it is said to have a double peristome; if only one row, a simple peristome.

Often the teeth are long and slender, and very sensitive to moisture, curling up in various ways either inward or outward when dry; but rapidly becoming erect when moistened. The simple peristome and also the outer row, when it is double, grows from the inner lining membrane of the capsule.

The number of teeth is usually constant in the same species; but varies in different species, from four to sixty-four; the number always being a multiple of four, doubling itself regularly, as four, eight, sixteen, thirty-two and sixty-four.

The teeth are of many sizes, shapes, and colors; and vary greatly in their surface and structure. They are sometimes long, slender, straight, and entire, as in Barbula; or lanceolate and closely articulate, or broadly triangular with few articulations; or perhaps blunt and irregular in shape. Sometimes they are smooth and again they are either granular or densely papillose or lined with plates, or lamellate on the inner surface. Again, they may be bordered by hyaline edges, and marked down the center by divisural lines, or be split down the medial line; thus giving the paired arrangement of the teeth. Their color is usually the same as the capsule; but it is frequently different, it often being bright orange, purple, yellow, or hyaline, but most commonly brownish like the capsule. Some teeth consist of a single elongated cell, as in Barbula and others; or of a row of cells transversely jointed (articulated), called trabiculate.

The inner peristome develops from the outer wall of the spore sac. It is often a short membrane reaching but a short distance above the edge of the capsule, and frequently it is a thin, plaited cone-like membrane, with cilia between the segments or processes. The cilia are usually opposite the interspaces of the outer teeth, and are from one to three in number, always being hyaline, and often spurred, or appendiculate, or papillose. The segments are usually opposite the outer teeth, and sometimes adhere to them. These inner teeth are often shorter than the outer, and usually thinner and paler. These are also often papillose, hygrometric, or hyaline. (See plates.)

In Tetraphis pellucida and the Polytrichaceae the peristome consists of agglutinated filaments. These differences in the teeth are used by Mitten, an English bryologist, as a basis of division, separating all mosses into two divisions—Arthrodonti, those with jointed teeth, and Nematodonti, those having filamentous teeth.

In the genus Polytrichum the top of the columella expands into a membrane, closing the mouth of the capsule, and joined to the top of the teeth, and is called the epiphragm, or tympanum.

The teeth are supposed by some writers to aid in scattering the spores by their hygroscopic properties, which cause them to make considerable motion, in curling back and forth into various positions as the amount of moisture varies.

At any rate the spores are dispersed in some way, and find a moist place in which to germinate. This finishes the cycle of development and brings us back to the spore, our former starting point.

Many mosses, mentioned above as illustrations of various points, do not occur in Kansas, nor have I examined all, but I quote from the authority of the greatest bryologists.

All species thus far reported from this state by reliable authorities are arranged below in a key, which is but an abbreviation of "Barnes's Artificial Key to North American Mosses," or, perhaps, more properly speaking, it is modeled from Barnes's Key. I have arranged this key for the convenience of other students of our Kansas mosses, knowing that it is very far from complete, but hoping to add to it myself at some future date, and feeling sure that whoever may take up this study will also add much more towards its completeness.

Many of the species included I have never collected or even seen; but they are reported by the best authority; and my list is mainly prepared from Renauld and Cardot's last list, published in the Botanical Gazette, March, 1892, with such additions as I have made from my own collection. All my identifications have been verified by Mrs. E. G. Britton; who has very kindly assisted and encouraged me in my work.

All species marked with a star or dagger I have in my collection and have examined closely; those marked with a small x were identified and studied by Renauld and Cardot, from specimens sent them by Dr. Joseph Henry, of Salina, and published in the Botanical Gazette, Vol. XVII, p. 82. All species not marked at all are reported in other lists, as "Washburn Bulletins," or "Smyth's Check List;" while those marked by a double dagger are new species.

The number following the name of a genus or species in this key refers to the page of Lesquereux and James's Mosses of North America, where the description is to be found.

ANALYTIC KEY TO THE GENERA OF KANSAS MOSSES.

ORDER I.—SPHAGNACEAE.

Capsule dehiscing by a deciduous operculum; peristome none;
leaves composed of large hyaline cells, with intervening rows
of small chlorophyllose ones. Genus single.....x Sphagnum molle Sulliv. 18

ORDER II.—ANDREAEACEAE.

?

ORDER III.—ARCHIDIACEAE.

Capsule bursting irregularly; spores few and very large. Genus single ....x Archidium Hallii Aust. 51

ORDER IV.—BRYACEAE.

Capsule bursting irregularly (spores numerous) or generally dehiscing by a deciduous operculum; in the latter case usually furnished with a peristome. Leaves not sphagnoid. Genera numerous, and as follow:

I. CLEISTOCARPI.—Capsule without a deciduous operculum.

A. Green protonema persistent.

Leaves ecostate.
  Capsule colorless.................................... x Micromitrium, 37
  Capsule colored....................................... x Ephemerum, 37
Leaves costate.. x Ephemerum, 37

B. Green protonema not persistent.

Margins of leaves flat or incurved.
  Leaves linear-lanceolate to subulate or abruptly pointed.
    Capsule cucullate.................................... x Pleuridium, 43
Margins of leaves more or less revolute.
  Capsule short-pointed.
    Calyptra mitrate.................................... x Microbryum, 45
    Calyptra cucullate...................................... x Phascum, 41

II. STEGOCARPI.—Capsule with a deciduous operculum.

A. ACROCARPI. Flowers and fruit terminating the stem, either the main shoot or a branch.

1. Mouth of capsule naked.

* Leaf-cells isodiametric, at least above the middle of the leaf, often obscure.

Lid imperfectly formed, persistent............................. x Astomum, 51
Lid perfect, deciduous.
  Capsule immersed.
    Leaves lamellose.................................. x Pharomitrium, 100
    Leaves not lamellose, ciliate............................. x Hedwigia, 152
    Leaves with a hyaline hair-point.......................... x Grimmia, 134
  Capsule exserted, not ribbed when dry. Lid conic, beaked.
    Pedicel long.......................................* Gymnostomum, 52

* * Leaf cells plainly elongated, distinct.

Lid small, convex or short-conic; capsule microstome.
  Leaves subulate-dentate................................... x Bartramia, 53
  Leaves broad, entire; calyptra inclosing capsule............. Pyramidula, 196
Lid large (rarely small); capsule macrostome.
  Capsule dehiscing regularly above the middle, not covered by the calyptra..........................* Physcomitrium, 196

2. Mouth of capsule furnished with a peristome.

* Peristome single.

† Teeth articulate.

‡ Teeth eight.

Leaves thick and coriaceous.
[Orthotrichum and Ptychomitrium (S. Notarisia) may be found here.]

‡ ‡ Teeth sixteen; calyptra mitrate.

‖ Calyptra plicate.

Teeth cribrose, purple.................................... x Coscinodon, 154
Teeth filiform, trifid....................................... Ptychomitrium, 156
Teeth approximate or connate in pairs.
Lanceolate to subulate, papillose...................... Ptychomitrium, 156
Triangular lanceolate, articulate quadrate.
Basal leaf-cells hexagono-rectangular, hyaline..........* Orthotrichum, 164

‖ ‖ Calyptra not plicate.

Terrestrial, or on rocks.
More than 1 cm. high; leaf-cells small, quadrate or punctate, obscure; beak long or short, not clavate.
Teeth lanceolate, flat, subentire or cribrose, or 2-3-fid to the middle.......................................* Grimmia, 134
Teeth linear-lanceolate, 2-3-fid to below the middle, or cleft to base into filiform segments..........Rhacomitrium, 147

‡ ‡ ‡ Teeth sixteen; calyptra cucullate.

‖ Leaves distichous.

Leaves broad, with a prominent vertical wing ....* Fissidens, 81

‖ ‖ Leaves pluriseriate.

¶ Capsule unsymmetric, cernuous-inclined, or arcuate.

Teeth filiform, bifid from a membranous base.............. x Desmatodon, 110
Teeth irregularly lacerate or bifid to the middle or below.
Leaf-cells enlarged at the basal angles, oblong above, rectangular at base...* Dicranella, 64
Leaf-cells enlarged quadrate at the basal angles, linear at base, * Dicranum, 67
Leaf-cells of two kinds, in two or three layers ....* Leucobryum, 90
Teeth bifid to near the base.
Lid conic, leaves lanceolate.......................................* Ceratodon, 92

¶ ¶ Capsule symmetric, pendulous on a flexuous pedicel.

Teeth bifid to the middle....................................x Campylopus, 77

¶ ¶ ¶ Capsule symmetric, erect.

Teeth bifid to the common membranous base.
Leaves subulate to lance-subulate, from a broader base....* Leptotrichum, 105
Leaves lanceolate to linear-lanceolate.
Lid elongated-conic.................................... x Trichostomum, 108
Lid short-conic or beaked............................... x Desmatodon, 110
Leaf-cells not enlarged at the angles.
Teeth large, mostly cribrose.
Pedicel little longer than the often hair-pointed leaves......* Grimmia, 134
Teeth small, often truncate or rudimentary; leaf-margins involute above ....* Weisia, 55
Teeth entire.
Capsule oval to subcylindric, not ribbed when dry; teeth linear-filiform, connate at base.............. x Didymodon, 104
Capsule short-pyriform, turbinate when dry; teeth blunt......Seligeria, 96
Capsule globose; lid beakless, small.....................* Bartramia, 203

‡ ‡ ‡ ‡ Teeth thirty-two.
Teeth cancellate, filiform or linear; pedicel long, twisted to the left, * Barbula, 115

† † Teeth not articulate.

‡ Teeth thirty-two or sixty-four.
Calyptra cucullate; capsule symmetric or nearly............... * Atrichum, 255
Calyptra mitrate, densely hairy; capsule 4-6 angled, teeth 64, * Polytrichum, 263

* * Peristome double.

† Capsule symmetric, erect.
Teeth broadly or narrowly triangular-lanceolate; capsule ribbed, not twisted.
Leaf-cells at base hexagono-rectangular, hyaline ....* Orthotrichum, 164

† † Capsule unsymmetric, inclined, oblique, or pendulous.

‡ Inner peristome a membrane, carinate or cut into sixteen segments; these sometimes separated by cilia.

‖ Cilia very short, rudimentary or none.
Membrane latticed or cleft to the base into filiform appendiculate segments.
Pedicel none or very short, leaves ecostate...................* Fontinalis, 268
Membrane not cleft to the base.
Segments entire or interruptedly cleft along the middle line.
Shorter than the teeth or rudimentary.......................* Funaria, 200
Equaling the teeth in length; leaves not squarrose.
Leaf-cells narrowly rhombic-hexagonal, tending to linear, leaves narrower................................* Webera, 215
Leaf-cells and leaf broader................................* Bryum, 223
Segments bifid, divisions divaricate.
Leaves lanceolate to subulate, large.......................* Bartramia, 203
Leaves lanceolate or broader, plants smaller .... x Philonotis, 208
Segments filiform, united by fours at their tips.................* Timmia, 254

‖ ‖ Cilia present.
Appendiculate.
Leaves lance-subulate, cells linear.........................* Leptobryum, 215
Leaves broader, cells rhombic-hexagonal ....* Bryum, 223
Inappendiculate; capsule not ribbed when dry.
Leaves lanceolate, glossy, cells narrowly rhombic-hexagonal, inclining to linear ....* Webera, 215
Leaves large, soft, oblong-ovate or broader, cells round-hexagonal, * Mnium, 241

B. PLEUROCARPI. Flowers and fruit lateral, in the axils of leaves.
[Fontinalis may be found here.]

1. Peristome single (rarely none); teeth eight or sixteen.
Leaves distichous, with broad vertical wing...... ....* Fissidens, 81
Leaves serrate to ciliate-dentate ; capsule long pediceled.........x Fabronia, 294

2. Peristome double, the inner often imperfect.

* Segments none or short, or obscured by adhering to the teeth.

† Leaves papillose.

Entire, ovate to ovate-lanceolate.
  Teeth ciliate-papillose.......................................* Leskea, 301
  Teeth not papillose.......................................* Anomodon, 304
Spinulose-dentate to fimbriate (rarely entire), deltoid or round-ovate, * Thelia 298

† † Leaves not papillose; capsule straight; segments bifid or adhering to the teeth.

Plants small (1–2 cm.); capsules about 2 mm. long................* Pylaisia, 308
Plants large (4–6 cm.); capsules 4 mm. long..............* Cylindrothecium, 310

* * Segments not distinctly keeled, narrow; leaves costate; cells roundish to oval rhombic.

Stem and branch leaves similar....................................* Leskea, 301
Stem leaves much smaller than branch leaves..................* Anomodon, 304

* * * Segments distinctly keeled, often broad.

† Capsule symmetric, erect.

[Species of Hypnum with erect or suberect capsules may be found here.]

Leaves not papillose, ecostate; annulus large.
  Leaf-cells quadrate at basal angles.....................* Cylindrothecium, 310
Leaves ecostate; annulus small, narrow..........................* Pylaisia, 308
Leaves costate; plants dendroid.............................* Climacium, 313

† † Capsule unsymmetric, often arcuate.

Leaf-cells small; calyptra cucullate............................* Hypnum, 316

ANALYTIC KEY TO THE SPECIES OF KANSAS MOSSES.

SPHAGNUM, p. 12.

x S. molle Sulliv. 13.

Saline Co.; a very young and sterile form (Dr. Joseph Henry).

MICROMITRIUM, p. 37.

x Micromitrium sp. ?

Too young to determine. Saline Co. (Joseph Henry.)

EPHEMERUM, p. 37.

Leaves costate, costa excurrent; seta 0; capsule blunt-pointed.
  Leaves with long hyaline spinulose arista.......... x E. spinulosum B. & S. 3.
  Leaves papillose on both sides .... x E. papillosum Aust. 4.
    Both collected in Saline Co. by Dr. Henry.

PHASCUM, p. 41.

Capsule subglobose, apiculate.
  Leaf-margins plane or incurved, denticulate.... P. carniolicum Web. & Mohr. 1.
  Leaf-margins reflexed, quite entire................ x P. cuspidatum Schreb. 2.
    Costa prolonged into a long filiform point,
      x P. cuspidatum, var. piliferum B. & S.

P. carniolicum, in Western Kansas (Smyth's Check List). P. cuspidatum and var. piliferum were collected in Saline Co. by Joseph Henry.

PLEURIDIUM, p. 43.

Inflorescence autoecious; upper leaves long subulate.
  Serrulate from the middle upwards.................. x P. Bolanderi Muell. 5.
    Saline Co., sterile, by Jos. Henry.

MICROBRYUM, p. 45.

x M. floerkeanum Sch., var. henrici Ren. & Card.

This differs from the typical form in the green color of the plant, and the excurrent costa, often hyaline at the point. Saline Co., on sandy ground (Henry, Bot. Gaz., Vol. XIV, p. 91).

ARCHIDIUM, p. 49.

Autoecious, costa often long excurrent .... x A. Hallii Aust. 5
Saline (Henry).

ASTOMUM, p. 51.

Capsule solitary.
Brown, globose, leaves crispate....................... x A. crispum Hampe 1
Orange, subglobose, leaves crispate when dry .... x A. Sullivantii Sch. 3
A. crispum, Saline (Henry). A. Sullivantii, Saline (Henry).

GYMNOSTOMUM, p. 52.

Lid falling early; capsule thin walled, with 3–4 rows of transversely elongated cells at mouth.
Plants 1–7 cm. high, costa 70 micromillimeters wide at base with 4–6 guides............................* G. rupestre Sch. 2
Riley and Pottawatomie (M. Reed).

WEISIA, p. 55.

Inflorescence autoecious; teeth more or less perfect, or none.
Capsule wrinkled lengthwise when dry................. * W. viridula Brid. 1
Capsule narrower, lid long beaked, curved, teeth nearly entire.
* W. viridula, var. stenocarpa Muell.

W. viridula, Saline Co. (Henry); Wyandotte (Bennett & M. Reed); Riley, Pottawatomie, and Anderson (M. Reed). Var. stenocarpa, Wilson Co. (Cragin); Wyandotte and Riley (M. Reed).

DICRANELLA, p. 64.

I. Cells of exothecium rectangular quadrate; seta red; costa usually broad and indistinct below.
A. Leaves not sheathing, erect, spreading.
Costa percurrent, or excurrent; annulus none, peristome papillose.
Capsule cernuous, curved................................ * D. varia Sch. 6
Capsule erect, symmetric................................ D. rufescens Sch. 7
II. Cells of the exothecium prosenchymatous; seta often yellow; costa narrow and well defined below.
Seta yellowish.
Capsule cernuous, not strumose...................... D. heteromalla Sch. 10

D. varia, Shawnee (Cragin & Becker); Saline (Henry); common. It differs from the type in having a long beaked lid, teeth pellucid at apex, reddish at base, bifid, vertically striolate; it is probably a variety. D. rufescens (Smyth's Check List). D. heteromalla, Saline (Henry), a sterile form with shorter leaves; rather doubtful species.

DICRANUM, p. 67.

"In this genus the structure of the costa is of diagnostic value. It is either composed of similar cells (homogeneous) or composed of large parenchymose cells and small sclerenchymose cells (stereides); it is then heterogeneous. The large parenchymose cells (called guides)[1] form a row (seldom double) in the middle of the costa, touching each other tangentially. They are comparatively large, but little thickened, and either empty or starch-bearing."[2]

Dioecious; stems radiculous (often densely); costa with guides; capsule more or less arcuate.

Leaf-cells pitted; costa percurrent; leaves not undulate; guides in one row.

Perichaetial leaves abruptly subulate............ x D. scoparium Hedw. 17

In Labette (Nelson); Saline (Henry); sterile form, with leaves often broken at point.

CAMPYLOPUS, p. 77.

Costa smooth at back, auricles none.

Upper leaves with hyaline points.................. x C. henrici Ren. & Card.[3]

C. henrici, Saline Co. (Henry); sterile.

FISSIDENS, p. 81.

I. (Eufissidens.) Plants terrestrial or submersed, but not floating; leaves soft, of one layer of cells.

A. Fruit terminal.

1. Monoecious, male flowers axillary.

Leaf-cells larger, not densely chlorophyllose, nor in distinct rows, x F. bryoides Hedw. 2

2. Dioecious or monoecious, with male flowers terminal on a rooting branch at the base of the female stem.

Leaf-cells almost or quite isodiametric, often obscure; leaves with a narrow border, at least on vaginate lamina.

Margins of leaf-cells not papillose.................. x F. brambergeri Schw.

Serrulate at apex; auricles broadly margined.............. x F. incurvus Schw. 3, var. minutulus Sulliv.

Short acuminate, lid rostellate.. x F. incurvus Schw., var. exiguus Sulliv.

Leaves without a border.

Obtuse, cells pellucid, operculum conic..............* F. obtusifolius Wils. 17

Broader border of elongated cells on margin of vaginate lamina; and a narrow, more or less distinct border on the dorsal wing, x F. obtusifolius, var. Kansensis Ren. & Card.

Apiculate, operculum with acicular beak .... x F. osmundoides Hedw. 18

B. Fruit lateral.

Leaves bordered by several rows of paler, often incrassate cells.

Capsule erect or inclined, flowers dioecious, leaf-cells obscure, x F. decipiens DeNot. 19

x F. bryoides, Saline (Henry). F. incurvus, var. minutulus (Smyth's Check List). x F. incurvus, var. exiguus (Smyth's Check List). x F. obtusifolius, var. Kansensis, Saline (Henry). F. osmundoides, Brown Co. (Becker). F. decipiens (Smyth's Check List).

---

[1] Pringsh. Jahrb. f. Wiss. Bot., VI, 374.

[2] Cf. Limpricht: Die Laubmoose, p. 23.

[3] Renauld & Cardot: Bot. Gaz., XIII (1888), p. 197, pl. XIV.

LEUCOBRYUM, p. 90.

Capsule apparently lateral (by innovations).
  Leaves erect, spreading, oblong-lanceolate ....* L. vulgare, Hampe 1
    Plants smaller, half as long, leaves shorter and more crowded.
      Capsule smaller, pedicel shorter.......................L. minus Sulliv. 2
      L. vulgare, sterile, Bourbon Co. (Bennett). L. minus, in Smyth's Check List.

CERATODON, p. 92.

Stems 2–3 (sterile often 10) cm. long; teeth articulate for three-fourths of length.......................* C. purpureus, Brid. 1
  Collected in Shawnee (Fields and Smyth); Ford (Cragin); Saline, sterile form (Henry); Riley (Kellerman); Wyandotte (M. Reed).

SELIGERIA, p. 96.

Seta straight when moist.
  Leaves sharp pointed; cells above rectangular; spores measure 10–14 mmm............................S. pusilla, Br. & Sch. 1
  Reported from eastern Kansas (Smyth's Check List).

PHAROMITRIUM, p. 100.

Capsule immersed, globose, without peristome, enlarged at orifice after the falling of the lid; leaves soft, loosely areolate.
  Calyptra oblique, plurilobate.............................x P. subsessile Sch.
  Saline (Henry), with young form named by Austin P. exiguum.

DIDYMODON, p. 104.

Leaf-cells below rectangular.
  Leaf base red; margins above revolute...............D. rubellus, Br. & Sch. 1
  Also a new species, D. species nova? Ren. & Card.[1] D. rubellus (Smyth's Check List); and D. species nova? Saline Co. (Henry).

LEPTOTRICHUM, p. 105.

Dioecious; leaves slightly twisted.
  Stem leaves spreading; perichaetial leaves hardly sheathing.
    x L. tortile Muell., var. vaginans Lesq. 1
  Stem leaves imbricate; perichaetial leaves long, sheathing.
    x L. vaginans Sch. 2
Monoecious; plants short (5 mm.)
  Teeth cylindrical; nodose, articulate, leaves spreading.
    * L. pallidum Hampe 5
  L. tortile, var. vaginans (Smyth's Check List). L. vaginans, Saline (Henry). L. pallidum, Wilson (McClung); Saline, sterile form, with leaves often broken at tip (Henry); Labette, a doubtful sterile form (Newlon).

TRICHOSTOMUM, p. 108.

Lamina composed of one layer of cells, papillose.
  Margins reflexed or undulate, entire; annulus none... x T. tophaceum Brid. 1
  Margins plane or incurved; costa reaching apex, or excurrent, serrate above; base of leaf yellowish, with thick-walled rectangular cells .... x T. crispulum Br. 3

---

[1] Botan. Gaz., Vol. XVII, p. 81 (1892).

T. tophaceum (Smyth's Check List). T. crispulum, sterile, Pottawatomie (M. Reed); Saline (Henry).

DESMATODON, p. 110.

Capsule erect or nearly so; leaves without a thickened or hyaline border, papillose.
  Costa excurrent into a hair.
    Capsule cylindric (1:5-6); teeth divided half way or entire, dioecious, x D. plinthobius S. & L. 6
  Costa vanishing at apex, or forming a short point; leaves hyaline at base, margins revolute.
    Capsule long cylindric, leaves crenulate........... x D. arenaceus S. & L. 3

D. plinthobius, Saline, sterile (Henry). x D. arenaceus, sterile, Saline (Henry).

BARBULA, p. 115.

I. Leaves with jointed dichotomous filaments on costa.
Costa narrow, round; leaves thin, broad..................... § I. Chloronotae.

II. Leaves not filamentose.
Teeth from a low membrane scarcely projecting from the mouth.
  Plants small; leaf cells small.
    Perichaetial leaves little different from the foliage ..... § II. Unguiculatae.
    Perichaetial leaves long, sheathing or convolute......... § III. Convolutae.
  Plants robust (except B. cespitosa).
    Leaves entire; stems radiculous....................... § IV. Tortuosae.
Teeth from a high tesselate membrane....................... § V. Syntrichiae.

§ I. Chloronotae.

Leaves with hair points; tip of leaf concolorous; hairs serrate; leaves rounded, obtuse .... x B. henrici Rau.

§ II. Unguiculatae.

Teeth plainly twisted; leaves blunt, or mucronate by the excurrent costa; cells at base rectangular and pellucid; capsule oblong-elliptic to subcylindric; sub-incurved......................* B. unguiculata Hedw. 13
Leaves gradually pointed, papillose; cells at base roundish, quadrate, or short-rectangular; costa 70 micromillimeters wide at base, and tapering gradually.................................. x B. fallax Hedw. 13

§ III. Convolutae.

Leaves plane on margins, or recurved; capsule smooth; costa percurrent.......................... x B. convōluta Hedw. 32

§ IV. Tortuosae.

Leaves long-linear, acute, abruptly mucronate........... B. caespitosa Schw. 37

§ V. Syntrichiae.

Leaves not bordered; cells smooth.............. B. mucronifolia Br. & Schw. 43

x B. henrici (?), sterile (probably is Phascomitrium sessile, say Renauld & Cardot), Saline (Henry). B. unguiculata, variable, Shawnee, Wilson (Cragin); Brown (Becker); Saline (Henry); Riley (Kellerman). x B. caespitosa, Wabaunsee (Baldwin); Saline (Henry). B. mucronifolia (Smyth's Check List).

GRIMMIA, p. 134.

Seta shorter than capsule; lid falling with columella.......... § I. Schistidium.
Seta longer than capsule, arcuate............................ § II. Eugrimmia.
Seta straight.. § III. Guembelia.

§ I. Schistidium.

Leaves without hyaline points; capsule ovate-globose.
In small dense cushions, soft lurid green................ G. conferta Funck. 1
Leaves shorter, broad, obtuse........... G. conferta, var. obtusifolia Sch. 1
In loose cushions, coarse, fuscescent.................. * G. apocarpa Hedw. 3
Loose, leaves blunt; capsule turbinate, wide mouthed when empty,.....G. apocarpa Hedw. 3, var. rivularis Nees & Hornsch.

§ II. Eugrimmia.

Capsule not costate (or obscurely) when dry; leaves not reflexed; margins plane; capsule elliptical; collum 0..G. olneyi Sulliv.? 17

§ III. Guembelia.

Lamina above 2-4-stratose; calyptra mitrate.
Leaf margins plane.............................. x G. leucophaea Grev. 24
Leaf margins recurved; walls of basal cells sinuate........... .... x G. Pennsylvanica Schw. 22
Only the margins 2-4-stratose; leaves hair-pointed; annulus 0; calyptra mitrate, covering the whole capsule... ....G. calyptra Hook. 23

G. conferta, var. obtusifolia (Smyth's Check List). * G. apocarpa, Saline, sterile (Henry); Riley and Pottawatomie (Reed). Specimens blackish brown, and leaf points often broken; fruiting specimens common. G. apocàrpa, var. rivularis (Smyth's Check List). x G. olneyi? sterile and stunted form, Saline (Henry). G. Pennsylvanica (Smyth's Check List). G. calyptrata, Saline (Henry).

RACOMITRIUM, p. 147.

Leaves muticous; costa not lamellose; leaves not auricled nor decurrent, obtuse..........................R. aciculare Brid. 2

HEDWIGIA, p. 152.

Leaves falcate or curved at apex, pale green.
Capsule globose, lid broadly convex.............................H. ciliata Ehrh. 1

A stunted form, Saline (Henry).

COSCINODON, p. 154.

Costa forming a rough hyaline point, twice as long as the leaf... .... x C. Wrightii Sulliv. 2
Monoecious; leaves ovate lanceolate, abruptly acuminate; teeth cribrose............................... x C. Renauldii Card.

x C. Wrightii, Saline (Henry); x C. Renauldii Card., Saline (Henry). Bot. Gaz., XV (1890), p. 41, plate VI B.

PTYCHOMITRIUM, p. 156.

Plants small (1 cm.); leaves acuminate, nearly or quite entire.
Collum 0.
Teeth subulate (1:10); entire .... P. incurvum Sulliv. 2
Collum equaling one-third sporangium......... P. pygmaeum Lesq. & James 4

P. incurvum, and P. pygmaeum, Southeast Kansas (Smyth's Check List).

ORTHOTRICHUM, p. 164.

A. Stomata superficial.
Peristome double; capsule strongly costate.
Leaves not gemmiferous; teeth with punctulate areoles; capsule including collum subcylindric.
Leaves apiculate, minutely papillose.......... O. brachytrichum Schimp. 18
Capsule ribbed only near the mouth; peristome opaque, very papillose, reflexed when dry .... O. speciosum Nees 12
B. Stomata immersed.
Peristome simple; capsule faintly costate, bands (8, rarely 16) cinnamon-red........................... O. anomalum Hedw. 1
Capsule 16-costate, bands (16, rarely 8) yellow....... * O. cupulatum Hoffm. 3
Plants shorter, blackish; capsule shorter, urceolate......... .... * O. cupulatum, var. minus Sulliv.
Peristome double; capsule costate when dry, half immersed, obovate, contracted below mouth.
Leaves simple, often slightly papillose; neck not cupped...... .... x O. strangulatum Beauv. 19

O. brachytrichum, O. speciosum, O. anomalum (Smyth's Check List); * O. cupulatum, and * O. cupulatum, var. minus, Riley (M. Reed), x O. strangulatum, Saline (Henry).

PYRAMIDULA, p. 196.

Calyptra large, inclosing capsule, dehiscent by a lateral cleft; orifice naked.................................. x P. tetragona Brid.

Saline (Henry).

PHYSCOMITRIUM, p. 196.

Capsule exserted.
Leaves entire or nearly so.
Seta short, little exceeding leaves..................... * P. Hookeri Hampe 4
Seta much longer (5–10 mm.)
Leaves linear-lanceolate; collum 0................ x P. turbinatum Mich. 6
Leaves ovate-lanceolate; collum distinct....... * P. acuminatum B. & S. 5
Leaves serrate; cells at mouth of capsule transversely elongated, 5–7 rows; leaves acute, not bordered, P. pyriforme Linn. 2
Costa excurrent; seta short; annulus small, simple, falling in pieces .... * P. Kellermani Mrs. Britton

* P. Hookeri, Riley (Kellerman & M. Reed); Wyandotte and Pottawatomie (M. Reed); Franklin (Meeker); x P. turbinatum? sterile, Saline (Henry); P. pyriforme, Shawnee (Cragin); Brown (Becker); Labette (Newlon). * P. Kellermani, Riley (Kellerman); Wyandotte and Pottawatomie (M. Reed). * Physcomitrium Kellermani, Mrs. Britton, n. sp. Plants 3–5 mm. high; stem short, simple or with basal innovations; leaves few, rosulate, 3 mm. long, ovate triangular acuminate, vein excurrent; margins coarsely serrate, cells very lax, basal scarcely elongated; inflorescence monoecious; seta short, 1–2 mm. long, scarcely

exceeding the leaves, tapering into the neck, or even apophysate; capsule pyriform, 1–15 mm. long, bright golden brown; lid small, dense; beak short, sharp, mouth not broadly flaring when old, often contracted below it, bordered by 5–7 rows of elongated transverse cells and a persistent orange-colored annulus of smaller square, undifferentiated cells; neck short, stomata immersed, walls of the theca dense, regular; spores rough (25–30 mmm. in diameter), maturing in March or April. Manhattan, Riley Co., Kan., W. A. Kellerman, April 26, 1889, and March 6, 1889. (No. 38.) In moist sandy banks, near streams. Differs from Drummond's specimens of P. Hookeri in the smaller size of the plants, the lax, coarsely-serrate leaves, the shorter seta, more pyriform capsule, and especially in the annulus.

FUNARIA, p. 200.

Annulus large and revoluble; capsule distinctly striate — costate; leaves short-acuminate; lid large; spores 12–17 mmm. . . . . * F. hygrometrica Hedw. 8

* F. hygrometrica, Shawnee (Cragin); Labette (Newlon); Saline (Henry); Riley, Pottawatomie, and Wyandotte counties (M. Reed); usually small, very common.

BARTRAMIA, p. 203.

Capsule curved; lid oblique; peristome double; seta exceeding stems.

Leaves papillose only on upper surface. . . . . x B. radicalis Beauv. 8

Base not white, margins revolute, autoecious. . . . . * B. pomiformis Hedw. 6

B. radicalis, sterile, Saline (Henry), B. pomiformis Labette (Newlon); Franklin (Herrick).

PHILONOTIS, p. 208.

Leaf cells rectangular to linear; plants short (1–3 cm.)

Costa thick, rusty; leaves erect, spreading; capsule horizontal, x P. Muhlenbergii Brid. 1

Not uncommon, but sterile, Saline (Henry).

LEPTOBRYUM, p. 215.

Leaves narrow, flexuous, subulate, glossy; capsule inclined or pendent; lid apiculate; annuluslarge. . . . * L. pyriforme Schimp. 1

Collected in Pottawatomie county by Minnie Reed.

WEBERA, p. 215.

A. Annulus present; segments of endostome split and gaping along the keel; cilia well developed.

Inflorescence paroecious.

Capsule horizontal or pendent, not touching the seta; contracted below the mouth. . . . . W. nutans Hedw. 5

Inflorescence dioecious.

Uppermost leaves lanceolate (1:4–6); costa reaching apex. . W. annotina Schw. 9

B. Annulus 0.

Leaves sharply serrate; stem red; leaves glaucous green. . . . . . W. albicans Schimp. 18

W. nutans (Smyth's Check List); W. annotina, Shawnee (Becker); W. albicans, Brown (Becker); Wilson (Cragin); Saline (Henry); Riley, sterile, common (M. Reed).

BRYUM, p. 223.

Upper leaf cells rhombic to hexagonal; plants not from stolons.
Cilia 0, or if any inappendiculate............................ § I. Cladodium.
Cilia 2-4, appendiculate .... § II. Eubryum.
Plants from stolons .... § III. Rhodobryum.

§ I. Cladobryum.

Synoecious or heteroecious, costa long excurrent; endostome attached to peristome; spores smooth, about 30 mmm....................................B. pendulum Sch. 4

§ II. Eubryum.

A. Synoecious.
Costa long excurrent; endostome attached to peristome; spores smooth, about 30 mmm.................x B. bimum Schreb. 14
B. Dioecious.
Leaves pointed; costa percurrent or excurrent; capsule longer (1-3+), tapering at base, yellowish brown, slightly constricted below mouth; leaf margins revolute, serrate at apex.. x B. pseudotriquetrum Schwaegr. 38
Leaves pointed; costa vanishing, silvery; plants small; leaves closely appressed, imbricate; capsule purple, pendent ....* B. argenteum Linn. 29
Costa excurrent; leaves long cuspidate; capsule long (1-3); leaves erect and straight when dry; collum one-half the sporangium................* B. caespiticium Linn. 30

§ III. Rhodobryum.

Costa excurrent; margin revolute ⅔ to ¾ length; collum one-half sporangium, curved ....B. ontariense Kindb.

*B. pendulum (Smyth's Check List); Pottawatomie (M. Reed). B. bimum Saline (Henry); Shawnee (Cragin). x B. pseudotriquetrum, Saline (Henry); Southeast Kansas (Smyth's Check List). B. argenteum, Shawnee (Fields); Wilson (Cragin); Saline, sterile (Henry); Wyandotte, Riley, Pottawatomie and Anderson counties (M. Reed); Franklin (Meeker). * B. caespiticium, Saline (Henry); Riley, Pottawatomie and Wyandotte counties (M. Reed). B. ontariense, Saline, sterile (Henry). Torr. Bull., XVI, p. 96.

MNIUM, p. 241.

Leaves serrate; teeth of leaves single; stems simple or branched; not dendroid; basilar branches stoloniform.
Leaves acuminate, serrate to middle; lid convex, or mamillate; membrane of endostome lacunose, * Mnium cuspidatum Hedw. 1
Leaves acuminate, serrate to base; lid mammiform........x M. affine Bland 7
Stems slender; leaves pale-margined; capsule shorter and solitary ....M. affine, var. elatum B. & S.

* M. cuspidatum, Shawnee (Cragin, Smyth and others); Wabaunsee (Baldwin); Brown (Becker); Labette (Newlon); Wyandotte (Bennett and Reed); Riley, Pottawatomie and Anderson (M. Reed); Atchison (E. B. Knerr). Very common in the eastern half of the state.

x M. affine, Shawnee (Cragin); Saline (Henry). M. affine, var. elatum, sterile, found in Saline Co. (Henry).

TIMMIA, p. 254.

Capsule irregularly plicate when dry; segments appendiculate.. * T. megapolitana Hedw. 1

Shawnee (Smyth and J. W. Beede); Riley and Pottawatomie (M. Reed).

ATRICHUM, p. 255.

Costa lamellose on upper side only; lamellae 2–6, entire; lamina with teeth on lower surface.

Leaves acute, serrate for ¾ length.................. * A. undulatum Beauv. 1

Lamellae of leaves higher; capsule narrower and erect...... x A. undulatum, var. alticristatum Ren. & Card.

Leaves bluntish; serrate above middle only.

Teeth double, aculeate............................ * A. angustatum Brid. 2

Teeth single, short...................... * A. xanthopelma Lesq. & James 4

* A. undulatum, Saline (Henry); Bourbon (Bennett); Franklin (Meeker); Pottawatomie, Wyandotte and Riley (M. Reed). None of these specimens had clustered capsules, as described in Lesquereux's and James's Manual. * A. angustatum, Shawnee (Cragin); Labette (Newlon); Wyandotte (M. Reed); Saline (Henry). * A. xanthopelma, Saline (Henry); Wyandotte and Riley (M. Reed). x A. undulatum, var. alticristatum, Saline (Henry).

POLYTRICHUM, p. 263.

Leaves entire; margins inflexed, aristate at apex.

Awn hyaline, long.................................. P. piliferum Schreb. 3

Awn colored, short; leaves spreading when moist, subrecurved.............................. * P. juniperinum Willd. 4

Leaves serrate; marginal cells of lamellae semilunar, with two prominent papillae at corners.............. P. commune Linn. 6

* P. juniperinum, Pottawatomie Co. (M. Reed), and in Western Kansas (Smyth's Check List). P. piliferum, Western Kansas (Smyth's Check List). P. commune, Northeast Kansas (Smyth's Check List).

FONTINALIS, p. 268.

Perichaetial leaves abruptly pointed, entire.

Leaves not decurrent; teeth lacunose............ * F. dalecarlica Br. & Sch. 4

FABRONIA, p. 294.

Leaves ciliate-dentate.

Peristome of 8 geminate teeth; leaves costate nearly to middle.............................. x F. octoblepharis Schw. 3

Sterile, Saline (Henry).

THELIA, p. 298.

Papillae 2-4, furcate, usually bifurcate; teeth 1:17-20..... * T. asprella Sulliv. 2

Shawnee (Cragin); Brown (Becker); Franklin (Meeker); Riley and Anderson (M. Reed).

LESKEA, p. 301.

I. Costa reaching to or beyond the middle.

Not percurrent; leaves entire.

Endostome divided into segments.

Cleft between articulations; leaves bluntish........... L. obscura Hedw.? 2

Not cleft; leaves acute.............................. * L. polycarpa Ehr. 1
Endostome a short undivided membrane............... x L. Austini Sulliv. 6

II. Costa very short or none.

Leaf-cells rhombic.
Leaves of primary stem acute......................... * L. pulvinata Wahl. 7

* L. obscura, specimen scant; unable to determine positively; leaves not papillose; if L. obscura, it is probably a variety. Pottawatomie and Riley (Reed); Saline (Henry). x L. Austini, Saline (Henry). * L. polycarpa, Clay (Cragin); Shawnee, Brown (Becker); Wyandotte and Bourbon (Bennett); Pottawatomie, Riley and Anderson (M. Reed). This is a very common species; but varies considerably. * L. pulvinata ? differs from the type form considerably; it may be a new species or variety; collected in Pottawatomie and Riley counties by M. Reed.

ANOMODON, p. 304.

Leaves papillose; base not auricled, filiform-acuminate..*A. rostratus Schimp. 1
Leaves obtuse or apiculate; branches attenuate........ *A. attenuatus Hartm. 2
Branches not attenuate; leaves open, erect; teeth nodose...
*A. obtusifolius B. & S. 3

*A. rostratus, Wabaunsee (Baldwin); Wilson (Cragin); Franklin (Meeker); Riley, Pottawatomie, Anderson, and Wyandotte (M. Reed); Saline, sterile (Henry). *A. attenuatus, Wyandotte (Bennett); Riley (M. Reed). *A. obtusifolius, Shawnee (Fields); Brown (Becker); Saline (Henry); Wyandotte (Reed); common.

PYLAISIA, p. 308.

Segments half adherent to teeth; spores 19–20 mmm.
Leaves long-acuminate; margin not recurved ...... x P. intricata B. & S. 4
Leaves short-acuminate; margins recurved ....* P. Selwyni ? Kindb.
Segments wholly adherent; spores 28 mmm............* P. velutina B. & S. 5

x P. intricata, Jefferson (Cragin); Saline (Henry). P. Selwyni ? Kindberg (Ottawa Naturalist, II, 1889, p. 156); Riley (M. Reed). Could not be sure of this species, as it differed somewhat from the manual description; it may be a variety P. velutina, Riley (Reed).

CYLINDROTHECIUM, p. 310.

Capsule solitary.
Leaves acuminate-apiculate; teeth with 14–17 articulations; capsule 1:3.5–4 ....x C. cladorrhizans Sch. 1
Leaves abruptly short-apiculate; teeth with 6–8 articulations; capsule 1:5–5.5....................C. seductrix Sulliv. 2
Leaves not apiculate; teeth with 22–26 articulations; capsule 1:2.5–3....................... * C. compressum B. & S. 5
Distinctly serrulate; all basal cells rectangular; annulus large; teeth vertically striolate............ * C. Sullivantii Sulliv. ? 7

C. cladorrhizans, Saline (Henry), with a form much resembling C. brevisetum by its stems and branches less compressed, and pedicel shorter. C. seductrix, Shawnee (Cragin and Becker); Wabaunsee (Baldwin); Brown (Becker). * C. compressum, Saline

(Henry); Wyandotte, Riley, Pottawatomie, and Anderson (M Reed). * C. Sullivantii ? very doubtful; poor material; Wyandotte Co. (M. Reed).

CLIMACIUM, p. 313.

Capsule straight; lid rostrate, ovate-oblong (1:2.5-3); leaves slightly decurrent, and hollowed at basal angles.
C. dendroides Web. & Mohr. 1

Saline, sterile, (Henry); Shawnee, sterile (Smyth).

HYPNUM, p. 316.

I. Leaves spreading.

A. Leaf-cells short (1:3 or less).
 1. Leaves papillose; paraphyllia present.
Costa strong.
 Capsule cylindric, or if oval-oblong, then operculum long rostrate.
  Plants small (5 cm.), delicate, creeping, 1-2-pinnate; stem leaves long acuminate, cilia 1.......... H. gracile (?) B. & S. 10
  Plants large (10 cm.), creeping; 2-3-pinnate; forming wide, flat mats.
   Perichaetial leaves not ciliate; apical cells of branch leaves round............................ x H. recognitum Hedw.? 13
  Plants large (10 cm.), erect; 1-pinnate, in wide tufts; capsule narrowly cylindric. (1:5-6)........... * H. abietinum Linn. 15
 2. Leaves not papillose; unicostate or ecostate.
Leaves entire; plants creeping.
 Ecostate or with obscure traces of a nerve.
  Cilia 1-2, plants minute filiform, leaves ovate; long acuminate.............................. * H. confervoides Brid. 118
  Cilia 1-2, plants large, in wide, flat mats.......... * H. adnatum Hedw. 124
Leaves costate to apex; plants in loose tufts or mats, acuminate.
 Basal cells much enlarged..................* H. irriguum Hook. & Wils. 122
 Basal cells not enlarged ....H. irriguum, var. spinifolia Lesq. & James.
  Annulus triple....................................* H. radicale Beauv. 120
  Annulus simple..............................* H. orthocladon Beauv. 121
 Leaves not acuminate.............................* H. fluviatile Swartz 123
Costa ceasing above the middle; cells alike throughout.
 Inner perichaetial leaves with a short (¼ length) point.
  Capsule long-cylindric, arcuate; annulus triple...... * H. serpens Linn. 119
  Capsule oblong, oblique; annulus simple............* H. Kochii Br. & Sch.
 Inner perichaetial leaves subuliform-acuminate; cells vermicular.......................... x H. porphyrrhizum Lindb.
  Cells enlarged, rectangular at basal angles.
   Cilia appendiculate, equaling segments...........* H. riparium Linn. 127
    Plants slender, creeping; leaves narrow, serrulate at apex.
H. riparium, var. serratum Ren. & Card.
x H. riparium, var. cariosum Sulliv. ?
B. Leaf-cells elongated (1:5 or more).
 1. Leaves costate half way or more.
  a. Seta rough.
Lid convex-conic to long-conic; cells of basal angles scarcely different.

Leaves very short acuminate, glossy, not decurrent.... x H. rivulare Bruch 56
Leaves gradually acuminate, autoecious............... H. rutabulum Linn. 52
Lid (more or less long) rostrate; leaves acute or acuminate; cilia 2–3; leaf points not filiform.
Leaves serrulate all around; not decurrent nor excavate; acute segments perforate..................... x H. praelongum L. 75
Leaves entire at base; lid nearly as long as capsule.......* H. hians Hedw. 77
b. Seta smooth.
i. Lid (more or less long) rostrate.
Leaves apparently two ranked; plants of dry woods, * H. serrulatum Hedw. 89
Leaves spreading every way, ovate, acute, rarely slender-pointed; in water.................... * H. rusciforme Weis. 90
Leaves deltoid, with long, slender points; points straight; spreading branchlets attenuate........ H. strigosum Hoffm. 70
ii. Lid convex to conic.
* Leaves acute or acuminate, serrulate.
Capsule symmetric, erect.
Dioecious, large (branches 3–4 cm.)............ * H. acuminatum Beauv. 36
Capsule unsymmetric, inclined.
Capsule short (1:1.5) monoecious; leaves straight when dry, * H. salebrosum Hoff. 37
Stems long; leaves shorter, and short acuminate, indistinctly serrate................ H. salebrosum, var. longisetum B. & S.
Capsule longer (1:3) dioecious; leaves straight when dry.... * H. laetum Brid. 35
Leaves short, broader, more strongly dentate and more loosely areolate .... H. laetum, var. dentatum Lesq. & James
* * Leaves acute or acuminate, entire.
† Capsule strongly constricted under mouth when dry.
Leaves widest just at base, tapering equally; concave, smooth, cells plain..........................* H. polygamum Wils. 132
Leaves widest above base, long-acuminate.........* H. chrysophyllum Brid. 30
† † Capsule slightly or not constricted; plants whitish, yellowish or bright green; cilia 2; Monoecious, leaves open, H. salebrosum Hoffm. 37
2. Costa very short, or none or double.
a. Alar cells, abruptly enlarged, often inflated and colored.
Leaves not falcate, filiform-acuminate; alar cells few, large orange; plants stout, 7-10 cm. long; leaves quite entire..............................* H. stellatum Schreb. 131
b. Alar cells scarcely different, or quadrate, not abruptly enlarged.
Leaves complanate; lid rostrate; leaves not undulate, quite entire, H. sylvaticum Huds. 109
Leaves serrulate to base, bicostate; annulus large......* H. geophilum Aust. 87
Leaves equally spreading; capsule inclined or horizontal, often arcuate, and smooth when dry; leaves squarrose; abruptly long-acuminate............ * H. hispidulum Brid. 129

II. Leaves secund.

A. Costa single, reaching to middle or beyond.
Cells elongated; seta rough; leaves entire............... H. plumosum ? Swz. 58
Seta smooth; leaves not rugose, often plicate; paraphyllia none; annulus large.
Dioecious, leaves striate; teeth brown or dark orange, bordered; alar cells pellucid ....* H. aduncum Hedw. 132

B. Costa double, short, or none.

Lid conic, often apiculate; capsule oval to oblong (1:1–2.5); alar cells pellucid, short, yellow, thick walled...........H. curvifolium Hedw. 159

x H. recognitum? Saline, sterile (Henry); (Thuidium delicatulum). * H. abietinum, sterile, Bourbon (Bennett). * H. confervoides ? bright green areolation slightly chlorophyllose, leaves on young branches almost hyaline, Rooks (E. Bartholomew). * H. adnatum, Saline (Henry); Riley, leaves entire, costate to apex (M. Reed). * H. irriguum? with erect stem leaves, semitransparent in upper half, thick celled and chlorophyllose, the cells quadrangular but not enlarged at the base; capsule not constricted below the mouth; upper half of teeth hyaline; annulus two-celled; Riley (M. Reed). * H. irriguum, var. spinifolium? Riley (M. Reed). * H. radicale, differs from the type by being quite closely cespitose; plants small (½-1 cm.); areolation in some specimens nearly the same as base, cells rhomboidal, chlorophyllose, and more rectangular at base. The costa extends to below apex in some, and in others it is percurrent; segments entire and cilia as long as teeth; teeth closely articulate with a medial line distinct either half or entire length. This may be simply a local variation, or it may be a variety; or it may be a form of H. serpens, instead of H. radicale; found in Riley Co. (M. Reed). * H. orthocladon (H. varium); Saline (Henry), common; Riley (M. Reed). * H. fluviatile, branches attenuate, leafy to base; costa faint; leaves thin and delicate; found in a well curb, Riley (M. Reed). * H. serpens, very common and somewhat variable. Wyandotte, Riley and Pottawatomie (M. Reed); Saline (Henry); Brown (Becker); Jefferson (Cragin); Shawnee (Fields and Cragin). * H. Kochii[1], Saline (Henry); Riley (M. Reed); * H. porphorrhizum[2], Saline (Henry); Wyandotte (M. Reed). This is perhaps identical with H. hygrophyllum. H. riparium, Brown (Becker); Saline (Henry); Wyandotte (M. Reed). x H. riparium, var. serratum[3], Saline (Henry). Plants slender, creeping, and leaves narrow; serrulate at apex. x H. riparium, var. cariosum[3] ? Saline (Henry). x H. rivulare ? Saline (Henry); Wyandotte (Bennett). H. rutabulum, var. ? (Smyth's Check List). x H. praelongum, Saline (Henry). * H. hians, Shawnee (Fields); Wabaunsee (Baldwin); Jefferson (Cragin); Saline, sterile (Henry); Wyandotte (M. Reed). * H. serrulatum, Shawnee and Jefferson (Cragin); Wabaunsee (Baldwin); Franklin (Meeker); Wyandotte and Riley (M. Reed). * H. rusciforme (Smyth's Check List); Riley (M. Reed). H. strigosum, Wabaunsee (Baldwin). * H. acuminatum, Shawnee (Fields); Brown (Becker); Wilson (Cragin); Saline (Henry); Riley and Pottawatomie (M. Reed); common but sterile. H. salebrosum, var. longisetum (Smyth's Check List). * H. laetum, Shawnee (Becker); Wabaunsee (Baldwin); Labette (Newlon); Bourbon (Bennett); Saline, sterile (Henry); Pottawatomie, Riley, and Wyandotte, sterile (M. Reed). x H. laetum, var. dentatum, Saline, sterile (Henry). * H. polygamum?, Riley, specimens not quite mature (M. Reed). * H. chrysophyllum, Labette (Newlon); Wyandotte and Riley (M. Reed). H. sylvaticum, Saline (Henry), sterile. * H. geophilum ?, Wilson, immature (McClung). * H. hispidulum, Shawnee (Cragin); Brown (Becker); Saline (Henry); Riley (Reed). Basilar cells of leaves but slightly granulose; seta four times as long as branches, operculum but slightly apiculate. H. plumosum?, Shawnee (Fields); Saline (Henry). * H. aduncum, Saline, sterile, (Henry); Pottawatomie and Riley (M. Reed). H. curvifolium (Smyth's Check List).

---

[1] Bot. Gaz., XIV, p. 99.

[2] Bot. Gaz., XIV, 1889, p. 99. Ren. & Card.

[3] Ren. & Card. Bot. Gaz., XIV, 1889, p. 98.

In looking over the entire list of Kansas mosses, I find there are 165 distinct species, besides about 10 varieties, reported up to the present date. This list is necessarily very incomplete, as but a small portion of the Kansas mosses have been collected and studied.

Of the 23 tribes found in North America, 14 only are represented in this list. They are the following: Phasceae, Weisiae, Pottieae, Grimmieae, Orthotricheae, Tetraphideae, Physcomitrieae, Bartramieae, Bryeae, Polytricheae, Fabroneae, Leskeaceae, Orthothecieae, and Hypneae.

The 128 genera found in North America are represented by 50 genera in Kansas. Forty-five of the 165 species are found in the immediate vicinity of Manhattan; while about 30 have never been reported from Kansas before.

Nearly all collecting has been done in the eastern third of the state, so that the mosses of the remaining two-thirds are unknown, except for a few scattering specimens.

Almost one-fifth of the moss flora of Kansas belongs in the great genus Hypnum; about one-half are distinctly eastern species; 10 are southern; 3 are Rocky Mountain species; 2 are Californian; about a dozen are central; 10 are distinctly Kansan; and the remainder are cosmopolitan species.

This shows that our moss flora is composed of vagrants from every region in North America, as here is the middle ground where the different flora meet, or overlap; Kansas being the extreme limit of many species.

When the mosses of the western part of the state are more thoroughly studied, no doubt some entirely new species will be added to the present list, while the conclusions may be quite different from those now reached, for there is reason to believe that mosses, as well as other plants of the western plains, are quite characteristic. However, there is no doubt that as we go further west on the arid plains, the number of mosses decreases with the moisture until we reach the Rocky Mountains, where there is both shade and moisture to favor their growth.

Manhattan, Kan., June, 1893.

EXPLANATION OF PLATES.

NOTE.—All measurements in the plates are one-third that given in the explanation.

PLATE I.

(a) Weisia viridula Brid. var. stenocarpa Muell., x 25. (b) Part of the peristome showing teeth in pairs, x 500. (c) Spore showing papillous surface, x 500. (d) Cells of the leaf at apex. (e) Cells of base of leaf. (f) Comal leaf much enlarged. (g) Male flower showing antheridia and paraphyses, and perigonial leaves. (h) Tip of leaf, showing the incurved edges. (i) Antheridium greatly enlarged. (j) A dry plant of Weisia viridula Brid., x 2. (k) Capsule showing the peristome. (l) Peristome many times magnified, with two spores. (m) A leaf, x 20. (n) Cells at apex of leaf. (o) Cells at base of leaf.

PLATE II.

(a) Plant of Dicranella varia Schimp., with fruit. (b) Dry capsule more enlarged, showing the curved beak of the operculum. (c) Spores equivalent to 27 mmm. (d)Bifid tooth with a part of the edge of the capsule. (e) Tip of leaf, showing the cells. (f) Leaf enlarged considerably. (g) Basal cells of the leaf.

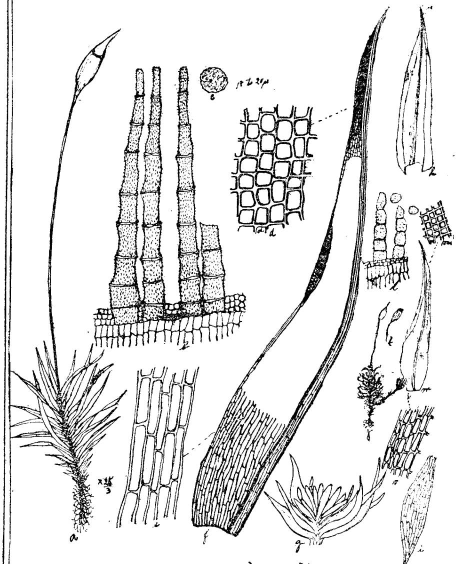
PLATE III.

(a) Dicranum scoparium Hedw. from a New York specimen, x 5. (b) Capsule with operculum, dry, x 5. (c) A part of a male plant showing antheridia in the axils of the leaves. (d) Leaf greatly magnified. (e) Basal cells of leaf. (f) Apical cells. (g) Two trifid teeth with spores. (h) Spores equivalent to 18 mmm. x 500. (i) Antheridium.

PLATE IV.

(a) Fissidens bryoides Hedw., from Switzerland, x 5. (b) Capsule and peristome, dry, showing constriction under the mouth. (c) Tip of branch more enlarged. (d) Perichaetial leaf enlarged, showing leaf cells. (e) Basal cells. (f) Cells at apex. (g) Ordinary branch leaf, much enlarged, showing cells and dorsal lamina. (h) Basal cells. (i) Apical cells and projecting costa. (j) Cross section near the base of leaf, showing the dorsal lamina and both halves of the true leaf. (k) Part of the peristome, showing one pair of teeth and the base of another. (l) Spore diameter, 10-14 mmm. (m) Fissidens obtusifolius Wils., Kansas, x 4. (n) leaf. (o) Capsule. (p) Spores.

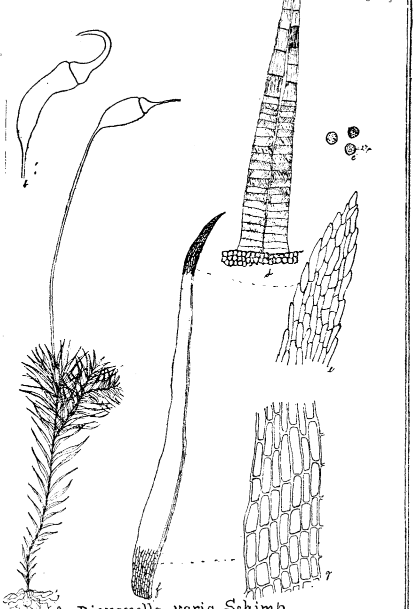
Plate I.



Weisia viridula Brid., var. stenocarpa Muell.

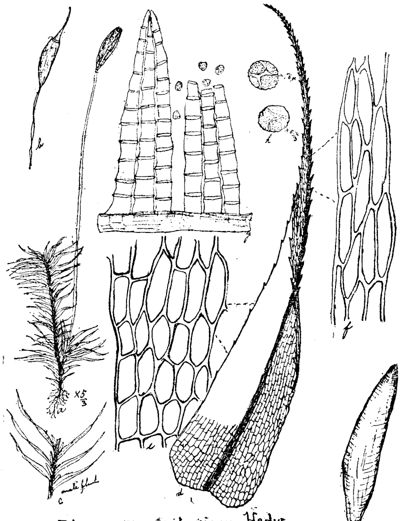
Weisia viridula Brid.

Plate II.



Dicranella varia Schimp.

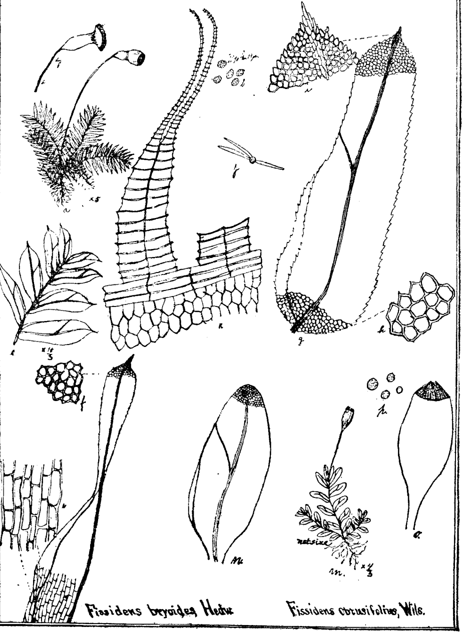
Plate III.



Dicranum scoparium Hedw.

M. Reed, Del.

Plate IV.



Fissidens bryoides Hedw.

Fissidens obtusifolius, Wils.

PLATE V.

(a) Sterile plant of Leucobryum vulgare Hampe, x 2. (b) A leaf, x 10. (c) Cells at edge of leaf, x 500. (d) Outer layer of leaf cells, x 500. (e) Inner leaf cells, showing water pores and chlorophyl grains, x 500. (f) Cross section of the leaf. (g) Cross section of one-half of the leaf, showing the outer cells with their water pores and the inner narrow chlorophyl cells between, x 500.

PLATE VI.

(a) Ceratodon purpureus Brid., x 6, showing the fruit with the cucullate calyptra, and conical lid. (b) The same dry, showing the angular shape of the capsule, with twisted seta and curled leaves, x 6. (c) Stem leaf near apex. (d) Basal cells. (e) Apical cells. (f) Perichaetial leaf. (g) Basal cells. (h) Apical cells. (i) Two teeth of the peristome, showing papillose surface, with upper edge of the capsule and a portion of the annulus. (j) Portion of the annulus. (k) Spores equal to 8-12 mmm. (l) Operculum. (m) Cells of the edge of operculum. (n) Plant of C. purpureus, from Switzerland.

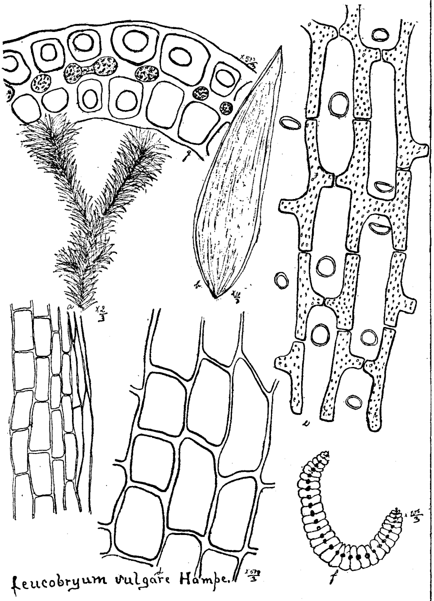
PLATE VII.

(a) Leptotrichum pallidum Hampe, x 3. (b) Dry capsule, showing ridges and slightly twisted peristome and seta. (c) Verruculose spores, diameter 18-20 mmm. x 500. (d) Obliquely rostrate operculum. (e) A portion of the peristome capsule, and annulus, showing the papillae on the slender teeth. (f) Stem leaf, x 15. (g) Basal cells, x 500. (h) Apical cells, x 500. (i) Outer perigonal leaf, x 100. (j) Middle cells, x 500. (k) Apex of same, x 500. (l) Inner perigonal leaf, x 100. (m) Basal cells, x 500. (n) Awn point, x 500. (o) Young fruit and plant of same, showing male flowers in axils of leaves, x 6.

PLATE VIII.

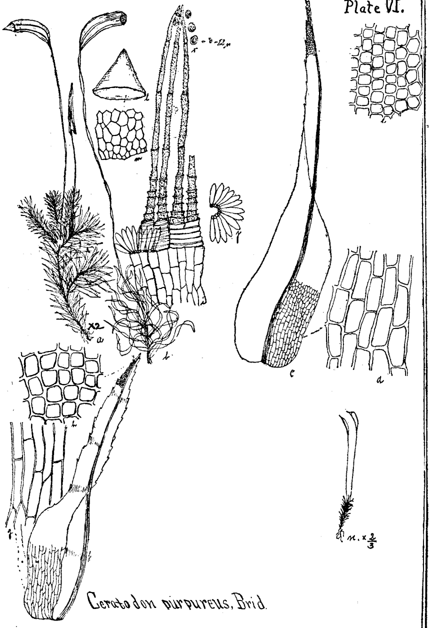
(a) Trichostomum tophaceum Brid., x 5, from California. (b) Dry capsule, showing lines and twisted seta, x 35. (c) Stem leaf. (d) Basal cells, x 500. (e) Apical cells, x 500. (f) A portion of peristome and edge of capsule, showing nodular and irregular forms of the teeth, with the large papillae, x 500. (g) The long rostellate operculum, x 35. (h) Spores, showing oil drops, diameter equal to 9-13 mmm., x 200.

Plate V.



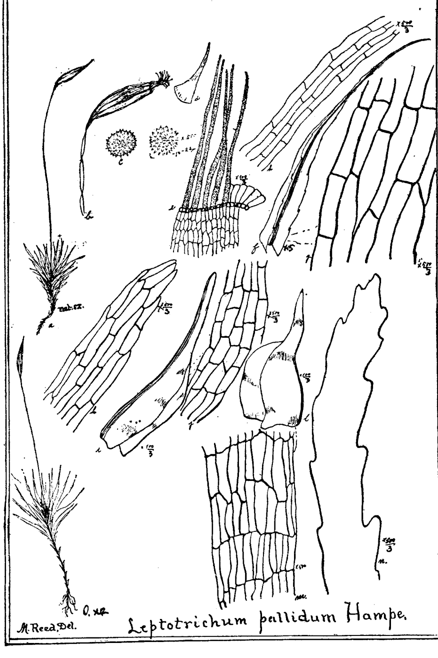
Leucobryum vulgare Hampe.

Plate VI.



Ceratodon purpureus, Brid.

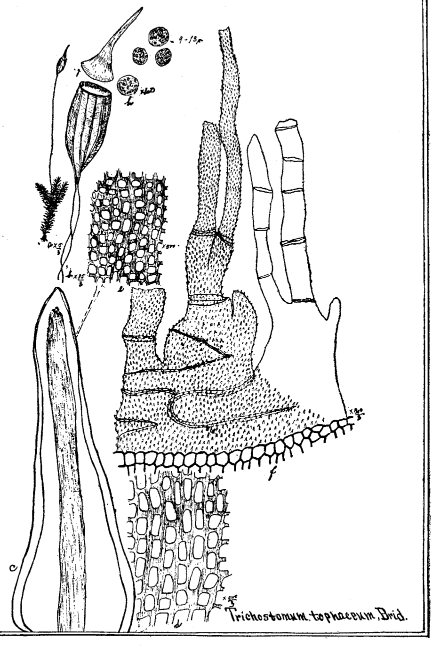
Plate VII.



M. Reed, Del.

Leptotrichum pallidum Hampe.

Plate VIII



Trichostomum tophaceum, Brid.

PLATE IX.

(a) Barbula unguiculata Hedw., x 15. (b) Dry plant of same, showing the twisted leaves, seta, and peristome, also the projecting columella, x 15. (c) Stem leaf, x 100. (d) Basal cells, x 200. (e) Apical cells, showing the papillae, x 200. (f) Cucullate calyptra. (g) Operculum. (h) Partly twisted teeth, showing the papillae, x 100. (i) Perichaetial leaf, x 60. (j) Basal cells. (k) Inner perichaetial leaf. (l) Spores, diameter equivalent to 9-11 mmm., x 200.

PLATE X.

(a) Ptychomitrium incurvum Sulliv., x 10, from New York. (b) Comal leaf, x 100. (c) Basal leaf, x 100. (d) Basal leaf, x 500. (e) Upper cells. (f) Part of the peristome and upper edge of the capsule, teeth bifid and densely papillose, x 200. (g) Part of the annulus, x 200. (h) Operculum. (i) Calyptra. (j) Spores, diameter equivalent to 9-12 mmm., x 500.

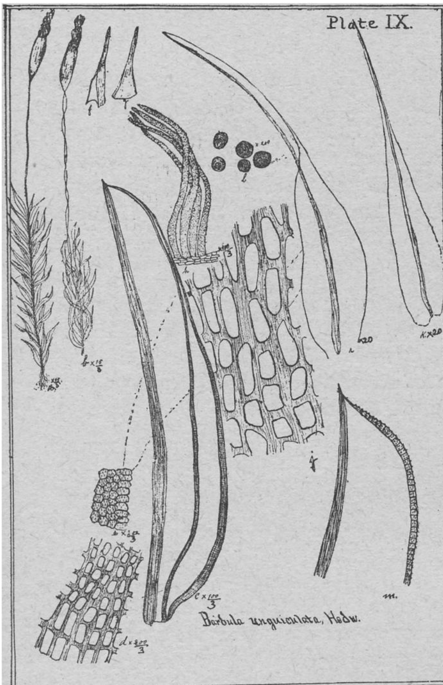
PLATE XI.

(a) Orthotrichum cupulatum Hoff., var. minus Sulliv., x 20. (b) The hairy calyptra. (c) Moist capsule, showing colored stripes and incurved peristome. (d) Dry capsule, showing recurved peristome. (e) Operculum. (f) Spores, diameter equivalent to 10-14 m., x 500. (g) Part of capsule, showing the square cells and one of the bifid teeth. (h) Enlarged leaf showing areolation. (i) Border cells. (j) Apical cells. (k) Stomata of capsule.

PLATE XII.

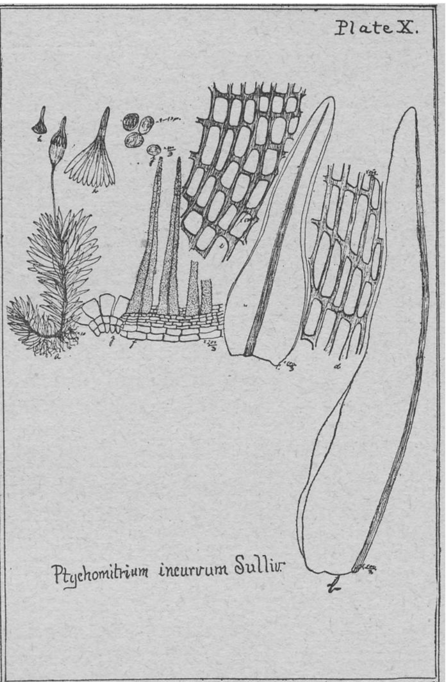
(a) Physcomitrium Kellermanii Mrs. Britton, x 1. (b) Plant of Physcomitrium pyriforme Brid., x 15. (c) Young capsule. (d) Cucullate calyptra. (e) Operculum. (f) Papillose spores, diameter equivalent to 25-30 mmm. (g) Comal leaf. (h) Basal cells. (i) Upper cells, showing chlorophyllose grains. (j) Cells of edge near apex of leaf. (k) Dry capsule. (l) Plant of Physcomitrium Hookeri Hampe, x 10. (m) A portion of the compound annulus and upper edge of capsule, showing the transversely elongated cells. (n) Papillose spores, diameter equivalent to 18-23 mmm. (o) Leaf, x 20. (p) Basal cells. (q) Apex of leaf. (r) Male plant, with the blossom.

Plate IX.



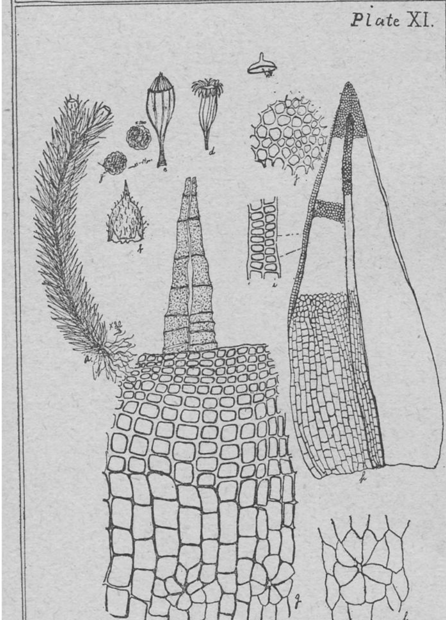
Barbula unguiculata, Hedw.

Plate X.



Ptychomitrium incurvum Sulliv.

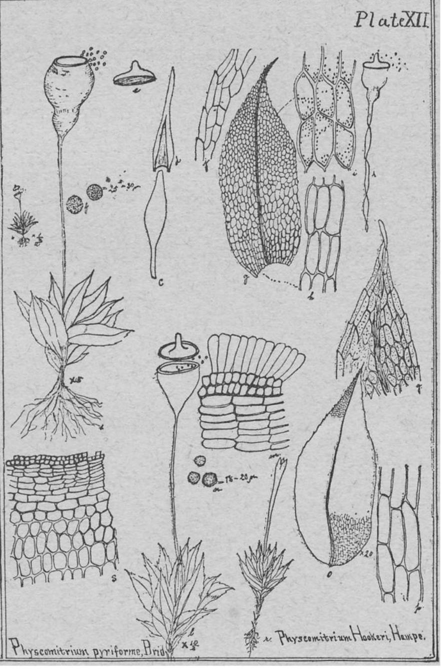
Plate XI.



Orthotrichum cupulatum, Hoff.. var. minus, Sulliv.

M. Reed del.

Plate XII.



Physcomitrium pyriforme, Brid.

Physcomitrium Hookeri, Hampe.

PLATE XIII.

(a) Physcomitrium Kellermanii Mrs. Britton, x1. (b) Same, x 10. (c) Operculum, x 10. (d) Base of seta, showing the vaginule, x 350. (e) Papillose spores, diameter equivalent to 25-30 mmm. (f) Calyptra inverted. (g) Leaf, x 35. (h) Apex of leaf, showing serrulate edge and apex, with excurrent costa, x 100. (i) Basal cells, x 100. (j) A portion of the annulus and capsule, showing transversely elongated cells. (k) Leaf cells from base, x 500. (l) Cells from Apex of leaf, x 500. (m) Part of capsule, showing stomata cells.

PLATE XIV.

(a) Funaria hygrometrica Sibth., x 8, showing the incurved peristome. (b) Dry plant of the same, x 10. (c) Young capsule, with calyptra, x 12. (d) Comal leaf. (e) Basal cells. (f) Apical cells, showing chlorophyl grains. (g) Operculum, showing thickened rim and spiral lines. (h) Side view, showing mamillate top. (i) Annulus. (j) Spores, diameter equivalent to 18-23 mmm. (k) Rim of lid, much magnified. (n) Base of seta, with undeveloped female flowers and paraphyses. (o) Archegonium. (p) Part of the outer and inner peristome, showing one tooth of each.

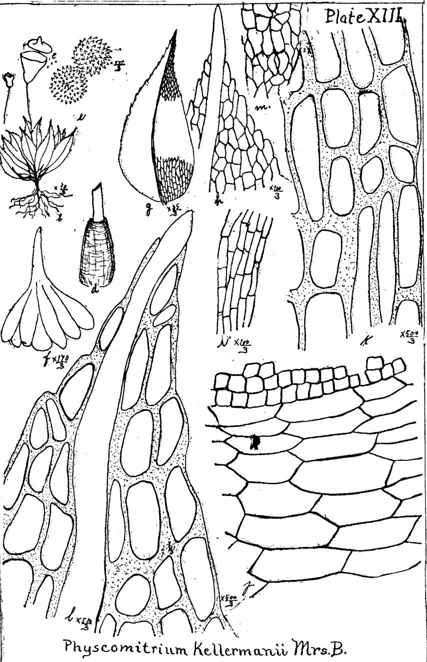
PLATE XV.

(a) Bartramia pomiformis Hedw., from Iowa, x 5. (b) Dry capsule with seta, x 15. (c) Operculum. (d) Leaf showing areolation, and serrate excurrent costa. (e) Basal cells. (f) Cells near apex. (g) Part of peristome and upper part of capsule, showing the projecting membrane which bears the peristome, also the divisural line on two teeth, with two cilia dividing each segment. (h) Papillose spores, diameter equivalent to 98-23 mmm.

PLATE XVI.

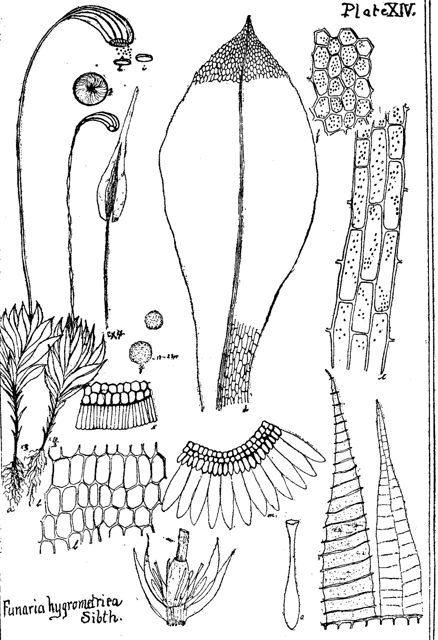
(a) Philonotis Muhlenbergii Brid., x 2, from Massachusetts. (b) Dry capsule, x 5. (c) Stem leaf, x 50. (d) Basal cells, x 500. (e) Apical cells, x 500. (f) Perichaetial leaf, x 50. (g) Branch leaf, x 50. (h) Basal cells, x 500. (i) Part of edge near apex, showing cells, x 500. (j) Part of inner and outer peristome. (k) Spores, diameter equivalent to 22 mmm., x 500.

Plate XIII.



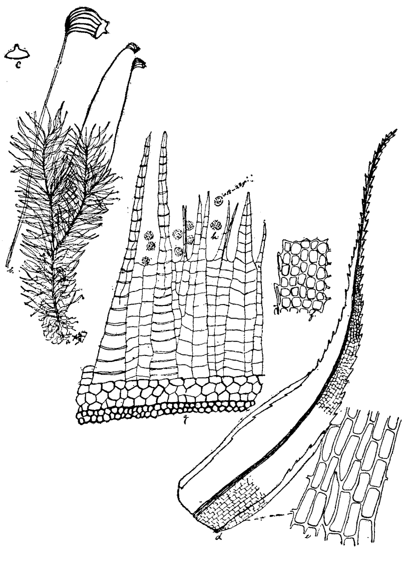
Physcomitrium Kellermanii Mrs. B.

Plate XIV.



Funaria hygrometrica Sibth.

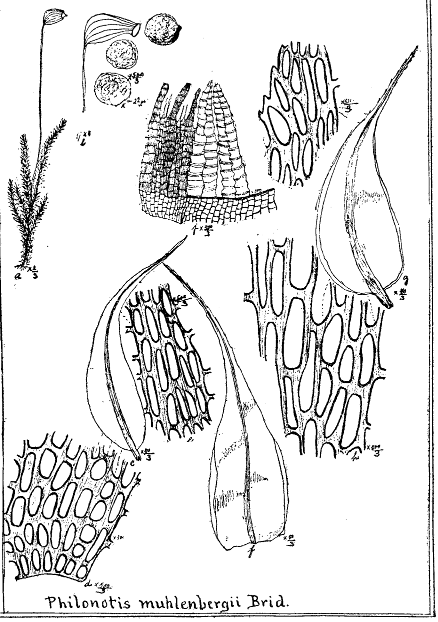
Plate XV.



Bartramia pomiformis Hedw.

M. Reed, Del.

Plate XVI.



Philonotis muhlenbergii Brid.

PLATE XVII.

(a) Leptobryum pyriforme Linn., x 10, from Nebraska. (b) A dry capsule. (c) The base of seta, with unfertilized archegonia and paraphyses. (d) Operculum. (e) Part of the edge of lid. (f) Part of the peristome, showing two outer teeth, one carinate segment, with cilia between. (g) Part of annulus. (h and i) Leaves. (j) Basal cells. (k) Apex. (l) Male plant. (m) Female. (n) Calyptra. (o) Perichaetial leaf. (p) Apex enlarged. (q) Middle cells. (r) Basal cells. l, m, n, o, p, q and r from an immature Kansas specimen.

PLATE XVIII.

(a) Sterile plant of Webera albicans Sch., x 3. (b) Stem leaf. (c) Upper branch leaf. (d) Apex of upper leaf. (e) Cells of the leaf. (f) Fruiting specimen of Webera albicans, from California, x 2. (g) Leaf. (h) Basal cells. (i) Upper cells. (j) Capsule and operculum, x 4. (k) Perichaetial leaf. (l) Apical cells. (m) Part of Peristome, both inner and outer. (n) Spores showing oil drops, diameter 18-23 mmm.

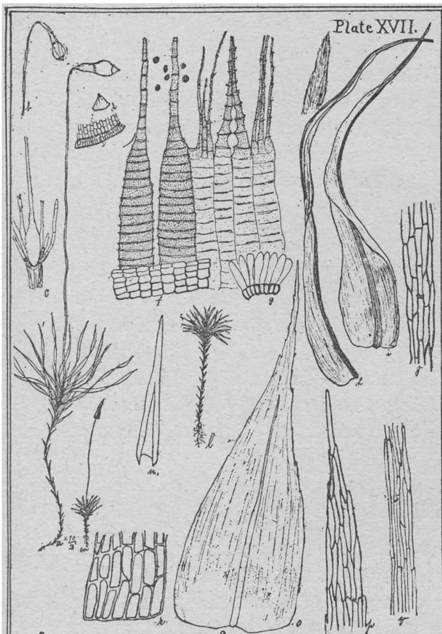
PLATE XIX.

(a) Bryum argenteum Linn., x 5. (b) Branch, with male flower. (c) Operculum. (d) Part of both inner and outer peristome. (e) Annulus cells. (f) Branch leaf. (g) Stem leaf. (h) Perichaetial leaf. (i) Cells. (j) Bryum caespiticium Linn., x 4. (k) Male plant of the same, x 5. (l) Capsule, x 8. (m) Part of peristome. (n) Part of annulus. (o) Comal leaf. (p) Basal cells. (q) Middle cells.

PLATE XX.

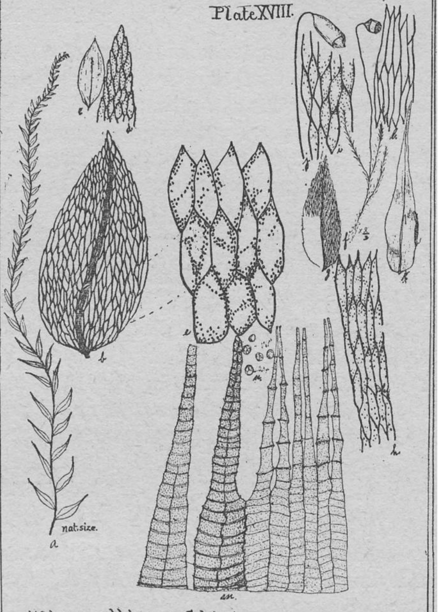
(a) Timmia megapolitana Hedw., x 3. (b) Tip of fruiting branch, showing young capsule with calyptra. (c) Filiform stoloniferous branch. (d) Calyptra on a younger capsule. (e) Capsule, with peristome. (f) Stem leaf. (g) Basal cells. (h) Apex of leaf. (i) Synoecious flower, showing base of seta, antheridia, paraphyses, and undeveloped archegonia, with the perigonial leaves inclosing them. (j) Latticed inner peristome, and two of the outer peristome. (k) Spores, diameter 18 mmm., x 500.

Plate XVII.



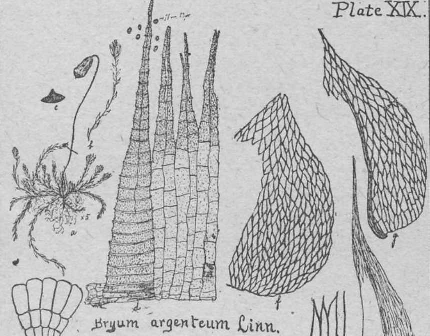
Leptobryum pyriforme Linn

Plate XVIII.

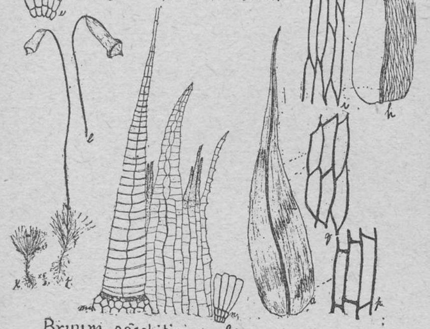


Webera albicans Schimp.

Plate XIX.



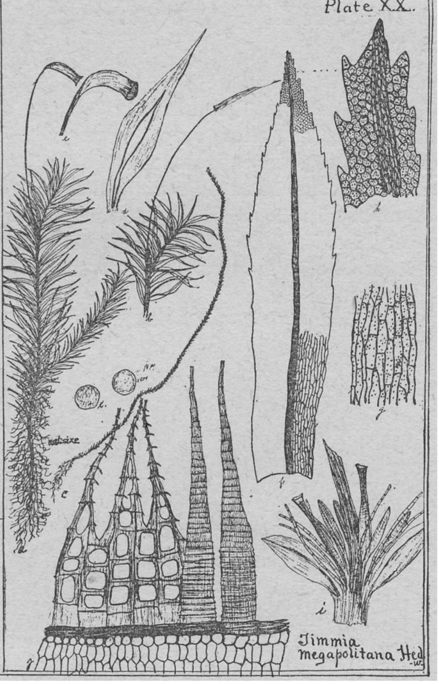
Bryum argenteum Linn.



Bryum caespiticium Linn.

M. Reed, del.

Plate XX.



Timmia megapolitana Hed

PLATE XXI.

(a) Mnium cuspidatum Hedw., x 8. (b) Comal leaf. (c) Basal cells and border. (d) Part of border cells near apex, showing chlorophyl grains. (e) Base of seta showing vaginule, antheridia, paraphyses and unfertilized archegonia. (f) Calyptra. (g) Spores, diameter 30-35 mmm., x 500. (h) Two outer teeth and part of upper edge of capsule. (i) Part of inner peristome. (j) View of peristome from above. (k) Operculum.

PLATE XXII.

(a) Atrichum undulatum Beauv., x 3. (b) Dry plant, natural size. (c) Male plant, x 3. (d) Male flower greatly magnified, showing antheridia in the perigonium. (e) Calyptra and capsule. (f) Operculum. (g) Upper leaf, x 60. (h) Basal cells, x 500. (i) Apical cells and border, x 500. (j) Basilar leaf. (k) Cross section of upper leaf, showing the laminae. (l) Perigonial leaf. (m) Part of peristome and upper part of capsule. (n) Spores, diameter 18 to 22 mmm., x 500. (o) Antheridia.

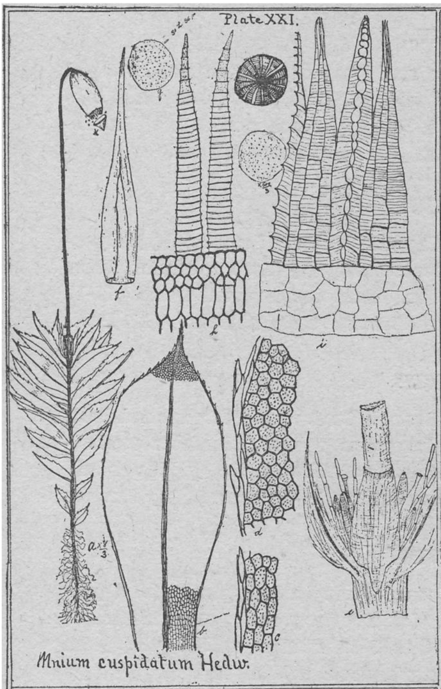
PLATE XXIII.

(a) Pylaisia Selwynii?, x 5. (b) Dry capsule. (c) Operculum. (d) Tip of male branch. (e) Part of the peristome, showing the inner adherent segments, and divisural line down the center of teeth; also part of the inner membrane, and upper edge of capsule. (f) Verruculose spores, diameter 17 to 22 mmm. (g) Branch leaf. (h) Cells of leaf. (i) Stem leaf. (j) Cells of leaf. (k) Perichaetial leaf. (l) Basal cells. (m) Upper cells. (n) Pylaisia velutina B.&S., x 2. (o) Stem leaf. (p) Perichaetial leaf. (q) Capsule. (r) Operculum. (s) Calyptra.

PLATE XXIV.

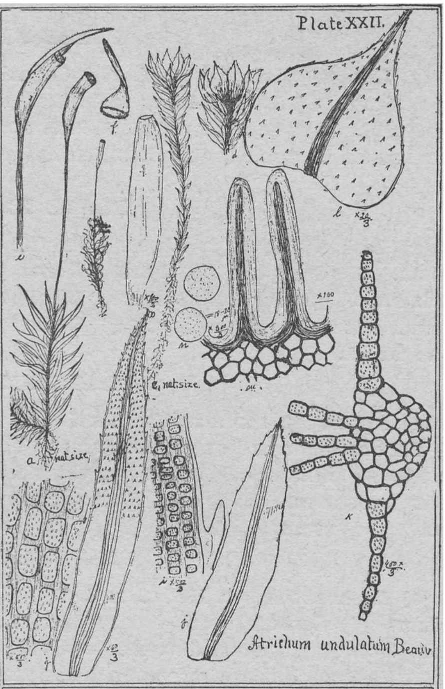
(a) Thelia asprella Sulliv., x 5, from a Wisconsin specimen. (b) Operculum. (c) Spores, showing oil drops, x 500. (d) Part of inner and outer peristome and edge of capsule, x 100. (e) Tip of papillose tooth, x 500. (f) Stem leaf, x 100. (g) Leaf cells and ciliate border of same, x 500. (h) Border and cells at base, x 500. (i) Upper rim of the capsule, much magnified. (j) Perichaetial leaf, x 100. (k) Tip of cilia on apex, x 500. (l) Basal cells, x 500. (m) Base of cilia from upper edge, x 500.

Plate XXI.



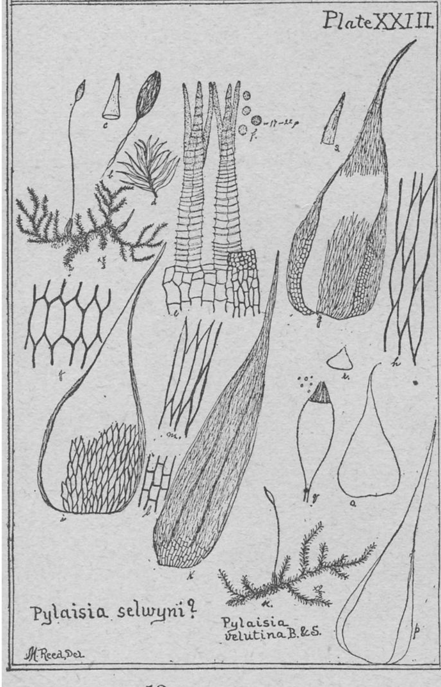
Mnium cuspidatum Hedw.

Plate XXII.



Atrichum undulatum Beauv.

Plate XXIII.

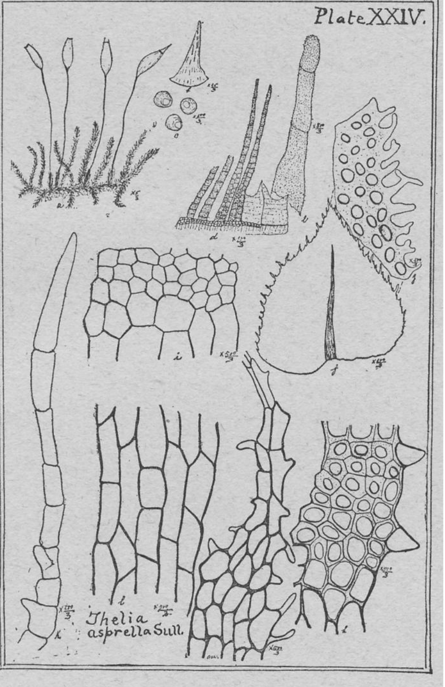


Pylaisia selwyni?

Pylaisia velutina B. & S.

M. Reed, Del.

Plate XXIV.



Thelia asprella Sull.

PLATE XXV.

(a) Leskea pulvinata Wahl. (b) Capsule and part of twisted pedicel. (c) Operculum. (d) Part of inner and outer peristome, with part of capsule. (e) Spores, diameter equivalent to 13-18 mmm., x 500. (f) Archegonia. (g) Archegonia much magnified. (h) Stem leaf. (i and j) Perichaetial leaves.

PLATE XXVI.

(a) Leskea polycarpa Ehrh., x 3. (b) Capsule enlarged more. (c) Operculum. (d) Calyptra. (e) Part of inner peristome. (f) Two teeth of outer peristome. (g) Part of annulus. (h) Spores, diameter equivalent to 11-13 mmm., x 500. (i) Stem leaf. (j) Border and inner cells of leaf. (k) Perichaetial leaf.

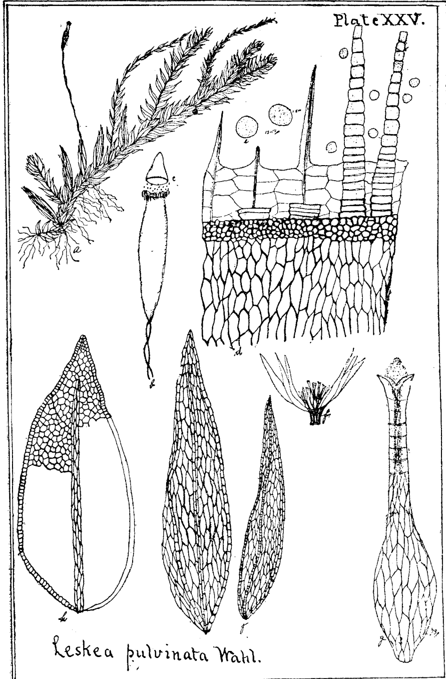
PLATE XXVII.

(a) Anomodon rostratus Sch., x 5. (b) Branch leaf. (c) Perichaetial leaf. (d) Part of inner and outer peristome. (e) Irregular spores, diameter equivalent to 8-10 mmm. (f) Anomodon obtusifolius Br. & Sch., x 5. (g) Inner and outer peristome. (h) Spores, diameter equivalent to 16-18 mmm. (i) Branch leaf. (j) Perichaetial leaf.

PLATE XXVIII.

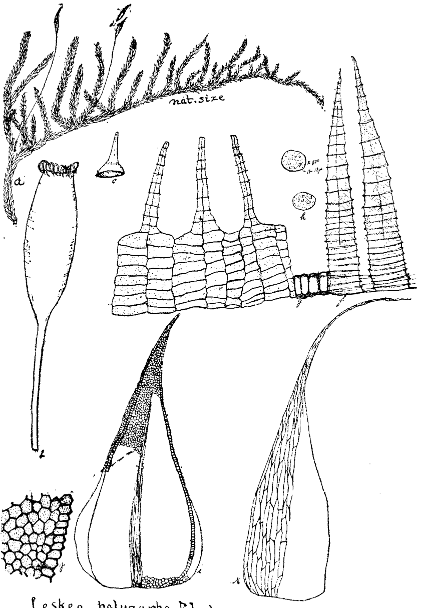
(a) Leskea obscura Hedw., x 3. (b) Young fruit in calyptra. (c) Operculum. (d) Capsule much enlarged, x 40. (e) Tooth greatly magnified. (f) Stem leaf. (g) Spores, diameter equivalent to 9-12 mmm., x 500. (h) Stem leaf. (i) Branch, showing young fruit, young branch, and male bud.

Plate XXV.



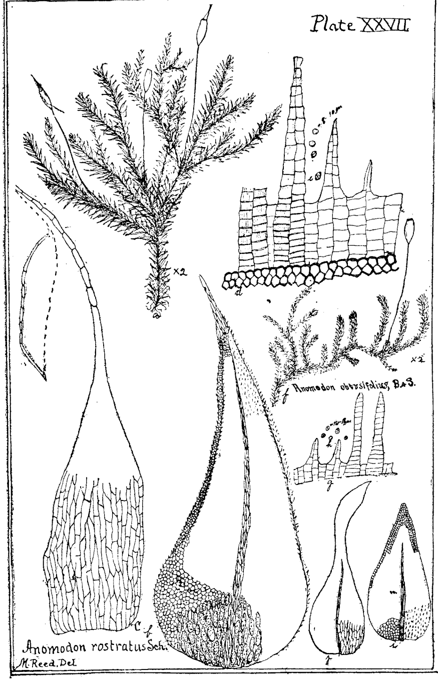
Leskea pulvinata Wahl.

Plate XXVI.



Leskea polycarpa Ehrh.

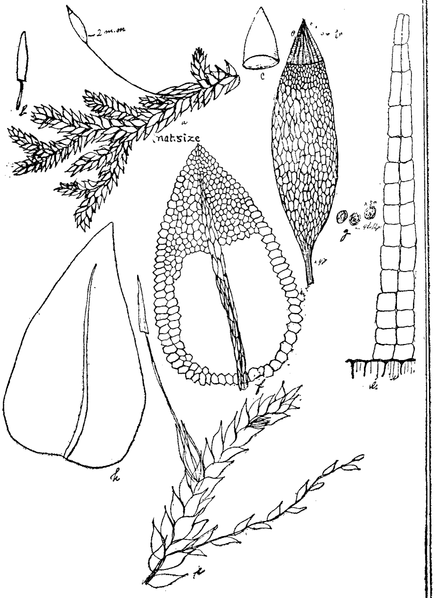
Plate XXVII



Anomodon rostratus Sch.

M. Reed, Del.

Plate XXVIII.



Leskea obscura Hedw.

PLATE XXIX.

(a) Cylindrothecium compressum B. & S., x 6. (b) Concave leaf from stem. (c) Basilar cells, x 500. (d) Cells from upper part of leaf, x 500. (e) Dry capsule. (f) A tooth of the peristome. (g) Spores, diameter equivalent to 9-13 mmm., x 500. (h) Perichaetial leaf. (i) Calyptra.

PLATE XXX.

(a) Hypnum porphorrhizum? Lindb., x 3. (b) Young capsule with calyptra. (c) Capsule. (d) Dry capsule more magnified, with apiculate operculum. (e) Part of inner peristome, showing carinate segments and cilia between. (f) Part of outer peristome. (g) Spores, diameter equivalent to 9 mmm. (h) Branch leaf, x 75. (i) Basilar cells, x 500. (j) Perichaetial leaf, x 70. (k) Cells of leaf, x 500. (l) Stem leaf, x 100. (m) Cells of stem leaf, x 500.

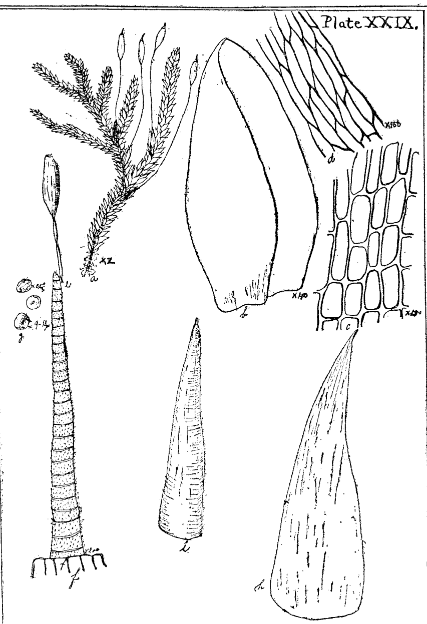
PLATE XXXI.

(a) Hypnum serpens Linn., x 2. (b) Part of branch, much enlarged. (c) Stem leaf. (d) Cells of leaf. (e) Part of peristome and upper edge of capsule, also part of annulus. (f) Spores, diameter 18 mmm., x 500. (g) Perichaetial leaf.

PLATE XXXII.

(a) Hypnum laetum Brid., with mature fruit. (b) Peristome, inner and outer. (c) Perichaetial leaf. (d) Stem leaf. (e) Operculum. (f) Spores, diameter 14-18 mmm., x 500. (g) Hypnum hians Hedw., x 2. (h) Capsule. (i) Calyptra. (j) Peristome. (k) Leaf. (l) Apex.

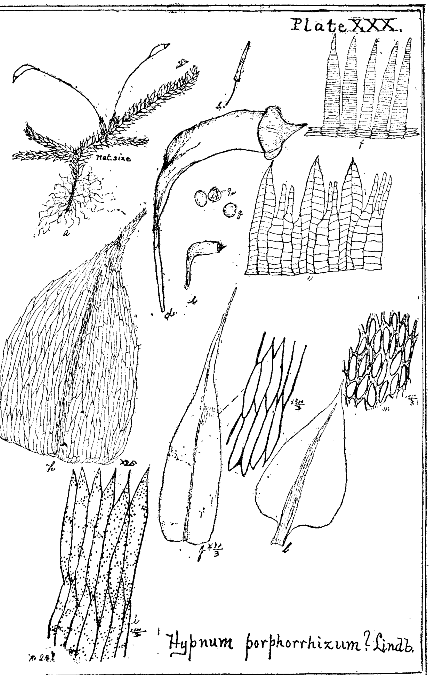
Plate XXIX.



Cylindrothecium compressum B.&S.

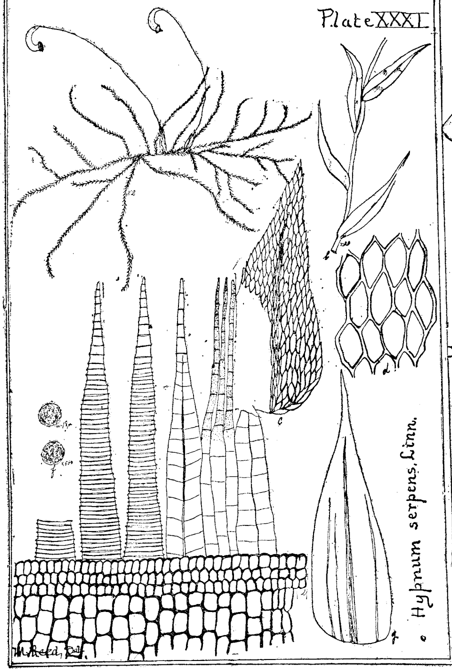
M. Reed, Del.

Plate XXX.



Hypnum porphorrhizum? Lindb.

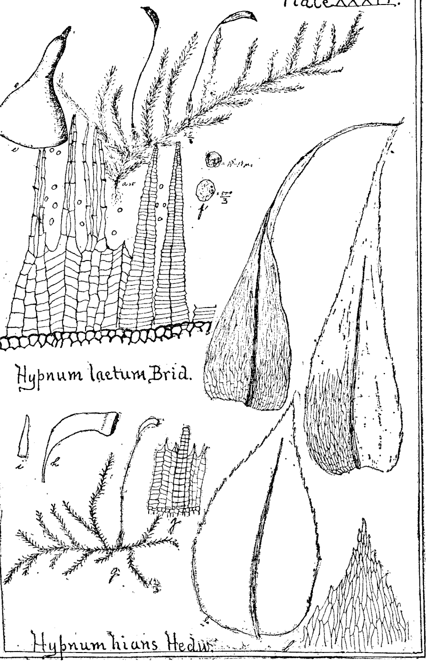
Plate XXXI.



Hypnum serpens, Linn.

M. Reed, Del.

Plate XXXII.



Hypnum laetum Brid.

Hypnum hians Hedw.

PLATE XXXIII.

(a) Hypnum abietinum Linn., x 3, sterile. (b and c) Stem leaves. (d) Papillose cells. (e and f) Paraphyllia, x 500. (g) Long paraphyllum, x 500.

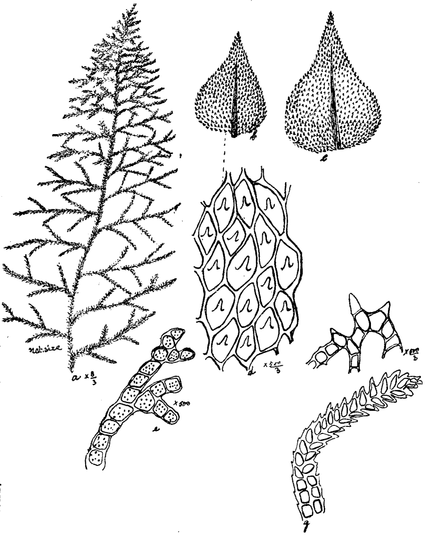
PLATE XXXIV.

(a) Hypnum hispidulum Brid., x 5. (b) Leaf, showing areolation. (c) Branch, x 45. (d) Perichaetial leaf. (e) Female flower. (f) Part of inner and outer peristome, also upper edge of capsule. (g) Spores, diameter equivalent to 7-10 mmm.

PLATES XXXV AND XXXVI.

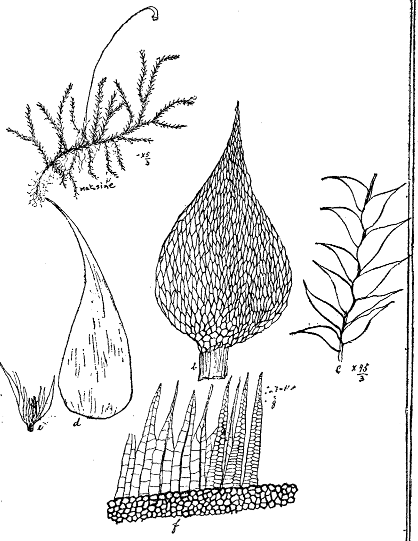
(a) Protonema of Pogonatum brevicaule Beauv., x 100. (b) Tip of same, x 500. (c)Gemmae of Tetraphis pellucida, x 500. (d) Pseudopodium of Tetraphis pellucida, x 6. (e) Cup containing the gemmae of same, x 20. (f) Spore germinating. (g) Same, in later stage. (h) Protonema, developed from spore, with leaf buds just starting; drawn from picture.

Plate XXXIII.



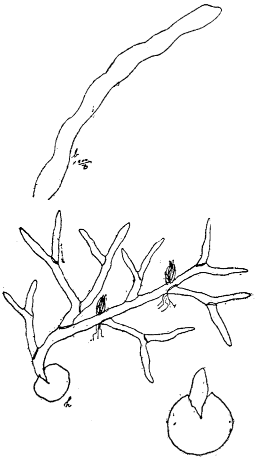
Hypnum abietinum Linn.

Plate XXXIV.



Hypnum hispidulum Brid.

Plate XXXV.

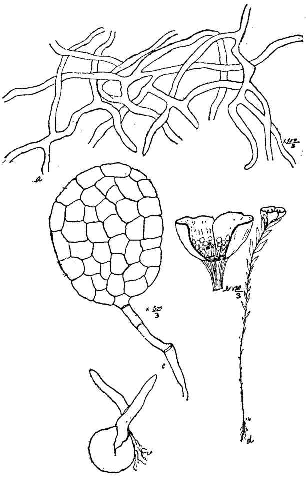


Pogonatum brevicaule Beauv.

M. Reed, Del.

Protonema

Plate XXXVI



Tetraphis pellucida Hedw.
Gemmae and pseudopodium.